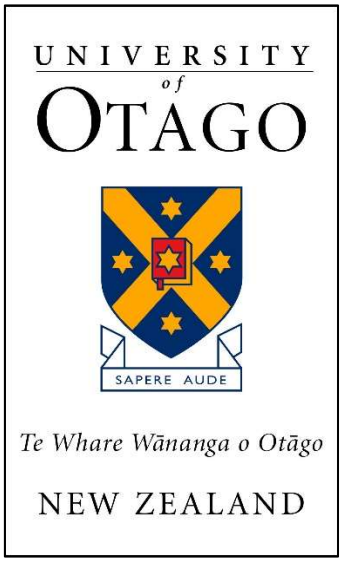
Sustainable Domestic Food Waste Practices in Dunedin's Tertiary Precinct



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Abstract

Food waste is a 'wicked' problem that has environmental, economic, ethical, socio-cultural and resource management implications. It is becoming increasingly important within environmental policy planning around the world.

In New Zealand, young adults and large households have been identified as significant contributors to domestic food waste levels. Limited research has been done on the types of barriers to sustainable domestic food waste practices that these demographic groups experience. Dunedin's tertiary precinct was selected as an ideal area for exploring such barriers due to its demographic trends.

The methods for data collection included an online survey open to residents of the tertiary precinct, complemented by interviews with key informants from a diverse range of positions within local institutions, local government, and student bodies. The research provided valuable insight into how several aspects of the local socio-cultural conditions, infrastructure, and the built environment hinder residents from minimizing domestic food waste and make it difficult for them to divert food waste from the landfill. Most of the barriers and issues that surfaced during this research are layered and inter-related to a high degree.

The timing of the research may be significant as several initiatives are in motion at both local government and tertiary institution level that have the potential to positively influence domestic food waste practices in the precinct. Recommendations were presented for how collaborative planning between actors can help address barriers to sustainable domestic food waste practices in the tertiary precinct and beyond.

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List of abbreviations

2nd Generation District Plan	2GP
European Union	EU
Greenhouse gases	GHG
Local Government Act 2002	LGA
Love Food Hate Waste	LFHW
National Policy Statement for Urban Development 2020	NPS-UD
Non-governmental organisations	NGOs
Otago Polytechnic	OP
Partially Operative Otago Regional Policy Statement 2019	RPS 2019
Students for Environmental Action	SEA
Territorial authorities	TAs
The Dunedin City Council	DCC
The New Zealand Waste Strategy 2010	NZWS
The Otago Regional council	ORC
The Resource Management Act 1991	RMA
The University of Otago	UO
The Waste Management Institute New Zealand	WasteMINZ
United Kingdom	UK
United Nations Food and Agriculture Organisation	FAO
United States Department of Agriculture	USDA
United States Environmental Protection Agency	EPA
Waste and Resources Action Programme	WRAP
Waste Minimisation Act 2008	WMA
Waste Minimisation and Management Plan 2020	WMMP 2020
Waste Minimisation Fund	WMF

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Chapter 1: Introduction

Food waste and loss is an increasingly important topic across the world, including in New Zealand. The food waste problem is multifaceted and can have wide-reaching implications. It represents a misuse of resources such as land, water, energy and money, it is a source of pollutants such as greenhouse gases, and it can be described as a manifestation of a gross social and economic inequity in our world (Jenny Gustavsson et al., 2011; Principato, 2018; Stuart, 2009).

Food loss and waste can occur at all stages throughout the food product's 'journey' – from farm or ocean to transit and storage, and from shop to kitchen to plate and eventually the landfill, compost bin or other depository. Large proportions of the food loss and waste that occurs in the world today could either be prevented in the first place, minimised or diverted from landfills towards more sustainable options, such as composting (Principato, 2018).

It is widely understood that minimising or avoiding the creation of food waste makes sense economically, socially and environmentally, not to mention ethically (Schanes et al., 2018; Stuart, 2009). Of course, sustainable disposal practices of food waste that cannot be avoided or minimised are also important for the sustainability of a society. But even if avoidable food waste is diverted from landfill and managed correctly, it is still a waste of food – and therefore still represents a social injustice and waste of the precious resources in our world.

Many countries and cities around the world now recognise the severity of the food waste issue (von Massow et al., 2019; Zero Waste Cities, 2020). In New Zealand, food waste and food waste-related issues have risen in priority on the government's waste minimisation agenda (Tucker & Farrelly, 2016a). Yet, as a society we still throw away large amounts of food every day; food waste makes up on average around 35% of our domestic waste, by weight (Waste Not Consulting, 2015).

It is also important to note how this waste of resources also conflicts with Te ao Māori (Māori worldview). A central concept in Te ao Māori is a natural balance between the environment and human communities. If the equilibrium of that relationship shifts, both systems comes out of balance. Te ao Māori 'holds that every person is connected both physically and spiritually through *whakapapa* (genealogy) and the strength of the collective determines success' (Beavis et al., 2019, p. 345). Maintaining the system's equilibrium is therefore important, and approaches to food waste have a role to play – both its prevention, and the way unavoidable waste is managed (Otago Waste Plan, 1997). By reflecting this profound interconnected relationship between people and nature, the indigenous Māori approach to resource management differs significantly from euro-centric approaches that often dominate planning in former European colonies (Harmsworth & Awatere, 2013; Njoh, 2007). It is important that food waste policy makers adhere to the principles of the Treaty of Waitangi and incorporate Te ao Māori into their decision making (Hayward & Wheen, 2004).

The reasons why some people act in environmentally responsible ways, and others do not, are extremely complex. Over the last few decades, much research has been conducted to examine the disconnect between environmental awareness and environmental action (the 'value-action gap' / 'awareness-action gap') (Blake, 1999; Kollmuss & Agyeman, 2002), and to identify barriers to environmental behaviour. Identifying the barriers to food waste minimisation behaviour experienced by New Zealand households would help in the effort of government agencies, non-governmental organisations (NGOs) and community individuals to encourage and enable households to reduce the amount of food waste they send to the landfill.

1.1 Research context

1.1.1 Young people and food waste

Over the past two decades, research on the many different aspects of food waste and related topics has been gathering momentum in different parts of the world (Principato, 2018; von Massow et al., 2019). However, research on food waste and food system planning in New Zealand is still in an emergent phase (Haylock & Connelly, 2018;

Tucker & Farrelly, 2016a), and data on the barriers to food waste minimisation experienced by households in a New Zealand setting remains limited. Nevertheless, food waste audits in 2014 and 2018 revealed some interesting results, among which was that large households (5+ household members) and households with young people (16-24 years) were identified as the highest food wasting households. This data justifies further research into the barriers to food waste minimisation experienced by young people in New Zealand. Today's young people are tomorrow's consumers, producers and policy makers and, as noted by Skinner et al., 'how they are enabled to engage in the environmental issues of today affects their attitudes and behaviours in the future (Skinner et al., 2012, p. 38).

1.1.2 Food waste and the built environment

From studies in the academic discipline of environmental psychology we know that there is a profound, reciprocal, and interactive relationship between humans and the built environment (Gifford, 2014; Mahmoud, 2018). An important relationship also exists between the built environment and waste behaviour (Crocker, 2012). Considering the concentrated immersion into the built environment that urban dwellers are exposed to every day, one could logically assume that this relationship would extend to domestic food waste behaviour. However, planning-related studies on the relationship specifically between the built environment and food waste behaviour are not well represented in the literature. Research into this niche subject is warranted; it has potential to shed light on barriers to sustainable behaviours in specific areas and thereby also potentially illuminate opportunities for overcoming them through city planning, architecture, or community collaboration (Burke & Napawan, 2020; Lake et al., 2020; Secondi et al., 2015)

1.1.3 Exploration of barriers in Dunedin's tertiary precinct

An excellent area to explore existing barriers to sustainable domestic food waste practices that may be related to both young people and the built environment aspect is the tertiary precinct in Dunedin city ('the tertiary precinct'). For the sake of clarity and focus, this study followed the definition of the tertiary precinct provided in the DCC Tertiary precinct development plan 2008 ('the precinct development plan') (Dunedin City

Tertiary Precinct Development Plan, 2008), which is the geographical area bordered by Duke Street, George Street, Hanover Street, and Harbour Terrace (a map of the area is contained in Appendix A). The tertiary precinct is a centrally located part of Dunedin in which the urban environment is characterised by the campuses of two major tertiary institutions: the University of Otago (UO) and Otago Polytechnic (OP). Surrounding these campuses is a highly urbanised precinct dominated by medium density residential housing. A student population of late adolescent youths and young adults make up the majority of residents occupying this residential housing (Dunedin City Tertiary Precinct Development Plan, 2008).

Another reason for choosing the tertiary precinct for this study was that the area is well known for being plagued with waste issues. A high level of household litter, broken glass and vandalised furniture is a common sight in many of the streets and residential properties of the precinct. This disorder is an issue that the council and the tertiary institutions in the area have been contending with for a long time (Morris, 2020a, 2020b; Otago Daily Times, 2014). Mismanagement of household waste (which includes food waste) was identified in the Dunedin City Council's Waste Assessment 2018 (table 11), stating that there is a high level of contamination in mixed recycling bins, confusion among the population about collection days, and insufficient capacity in existing council-issued recycling bins to accommodate the waste volumes from a student flat (Dunedin City Council, 2018). These documented waste issues may be a symptom of underlying cultural, systemic, or economic causes, and should be kept in mind when examining food waste-specific barriers.

1.1.4 A question of timing

The timing of this research is potentially optimal, as the issue of food waste is receiving increased levels of attention both nationally and locally. There are several strands of converging initiatives in the food waste planning space currently in motion, making this an opportune time to investigate the possible barriers to, and opportunities for, sustainable household food waste minimisation behaviour in the tertiary precinct. The most prominent of those are:

1. The topic of waste management is receiving increased media attention and public interest. Awareness of food waste is growing among civil society, albeit slowly. There are community organisations that are actively working on raising awareness, adding to pressure on central and local government for waste management and waste minimisation strategies to be improved (Haylock & Connelly, 2018; Mirosa, 2019).

2. There is increased awareness at national government level that New Zealand has a food waste problem, and increased concern about the repercussions that this has for the environment, the economy, and communities. The New Zealand government is also showing a strong interest in the circular economy approach (Ministry for the Environment, 2020c). A circular economy is based on principles of eliminating waste and pollution, keeping products and materials in use, and regenerating natural systems (Ministry for the Environment, 2020c). Systems and attitudes around how and why food waste should be minimised and treated would all determine how food waste and other organic matter re-enters the production chain and are therefore an important part of a circular economy. A report on an Environment Committee briefing on food waste in New Zealand was released in March 2020, providing recommendations on ways forward for the government in the food waste space (Mirosa, 2019; Webb, 2020).

3. The Dunedin City Council (DCC) released their updated Waste Minimisation Plan in July 2020. The DCC is also currently investigating options for improving their domestic refuse kerbside collection system, one of which involves incorporating the collection of food waste (Dunedin City Council, 2020c).

4. The Otago Regional council (ORC) is undertaking a review of the Regional Plan: Waste for Otago ('Otago Waste Plan') (Edwards, 2018; Otago Regional Council, 2020), which may have implications on how food waste may be managed in the region.

5. A DCC streetscape amenity and safety improvement project for the tertiary precinct is in its early planning and consulting stages (Dunedin City Council,

2020b), which has potential for positive signalling to be provided through the built environment in relation to food waste minimisation.

6. A new composting facility has been initiated at OP (Otago Polytechnic, 2019, 2020a).

7. UO is currently investigating solutions to processing food waste originating from their Dunedin operations (Otago Bulletin Board, 2019).

The above initiatives will be discussed further in Chapter 4, 'Dunedin context and related policies'.

1.2 Research objectives

This study aims at exploring the barriers to, and opportunities for, sustainable domestic food waste practices in the tertiary precinct. The study is niche in many respects: it only considers household food waste (i.e., not waste generated through institutions or businesses), it only includes households in the tertiary precinct, and it predominantly includes young people (due to the demographic of the tertiary precinct population). An additional angle was added to the study by an expressed consideration of whether, or to what extent, the built environment may be influencing food waste behaviours in the area.

The objectives of this research are to:

- identify the main existing barriers to sustainable food waste minimisation and management among households in the tertiary precinct, including considerations of the built environment,

- add to the growing body of food waste-related studies in New Zealand, and

- make recommendations on how individuals, community organisations and local authorities can help address the barriers to food waste behaviour in the tertiary precinct.

1.3 Research questions

Based on a preliminary literature review, the researcher hypothesised that the barriers to sustainable domestic food waste practices in Dunedin's tertiary precinct student households are complex products of multiple variables such as sociocultural backgrounds, environmental awareness and values, purchasing habits, household management, spatial and temporal constraints and the availability of local services (Evans, 2014; Principato, 2018; Skinner et al., 2012; Tucker & Farrelly, 2016a).

For the purposes of this thesis an important distinction is made between domestic food waste **minimisation** and domestic food waste **management**. Food waste minimisation includes each stage within a household that leads up to the point of which the household stops regarding the food as 'food' and starts regarding it as 'waste'. Food waste management includes the stages within a household after the food has become 'waste' (Principato, 2018; Quested et al., 2013). This distinction, and the distinction between avoidable, possibly avoidable, and unavoidable food waste, will be outlined in Chapter 2, 'Literature Review'.

This study examined both the barriers to household food waste minimisation and the barriers to sustainable household food waste management, incorporating a focus on the influence of the built environment. The study was guided by the following research questions:

Research Question 1

1A: What are the barriers to sustainable food waste minimisation practices among households in Dunedin's tertiary precinct?

1B: How does the built environment influence residents of the tertiary precinct's ability to minimise their domestic food waste?

Research Question 2

2A: What are the barriers to sustainable food waste management practices among households in Dunedin's tertiary precinct?

2B: How does the built environment influence residents of the tertiary precinct's ability to manage their domestic food waste sustainably?

1.4 Chapter outline

This thesis is divided into seven chapters, including this chapter (**Chapter 1**, 'Introduction') which introduces the research problem, explains why it is important, provides a justification for the study, and presents the research aim and research questions. **Chapter 2**, 'Literature Review', will survey and present international literature on the subject of domestic food waste, mapping out the use of different lenses through which the subject has been regarded previously. A conceptual framework will also be presented, which will help give the study direction and structure. Previously identified barriers to pro-environmental behaviour will also be reviewed, including psychological factors, socio-cultural factors, temporal factors, and the built environment. The chapter will also look at examples of international food waste policy. **Chapter 3**, 'Methodology', will then provide details of the methods used to address the research questions through data collection. Ethical considerations and limitations of the research will also be covered. In **Chapter 4**, 'Dunedin Context and Related Policies', the focus of the study will be narrowed to look specifically at the food waste landscape in New Zealand, including relevant national and local level policies and initiatives. **Chapter 5**, 'Barriers to Domestic Food Waste Minimisation' and **Chapter 6**, 'Barriers to Sustainable Domestic Food Waste Practices' addresses Research Questions 1 and 2; survey and key informant interviews will be presented according to themes and then discussed with

reference to the literature and policies. **Chapter 7**, 'Conclusion' will consolidate the key findings of the research and indirectly answer the research questions. Recommendations to local government and local tertiary institutions will also be made, and suggestions for future research will be presented.

Chapter 2: Literature review

Food waste is a global, multi-faceted problem that has environmental, economic, ethical, socio-cultural and resource management implications on many levels. Food waste at the household level makes up a significant portion of the overall volumes of food waste in developed countries (Food and Agriculture Organisation of the United Nations, 2019). Traditional views have tended to direct both the blame for household food wastage and the responsibility for minimising it towards the consumer. More recent scholarly discussions have questioned this tendency, pointing out that food waste is just as much a product of how modern lives are constructed as it is of individual neglect or carelessness (Evans, 2011). A thorough and multidisciplinary examining is called for to address the wide gap between awareness (or values) and action, and the barriers that prevent households and individuals from minimising and managing their food waste. For consumer food waste to be fully understood, it needs to be viewed together with the social and spatial settings that it sits within – a setting that has been created by, and is inextricable from, the wider socio-cultural, economic, and institutional world around it. Just as the blame for food waste should be shared, so should the responsibility for tackling it be. Food waste is a wicked, relentless problem that needs to be examined from a multitude of angles and that, in order to be addressed fully, requires a reimagining of the role and definitions of both food and waste in today's world (Evans, 2014; Närvänen et al., 2020a).

The subject of consumer food waste is an area of increasing international interest among academics, non-governmental agencies and policy makers (Mirosa, 2019; von Massow et al., 2019). This chapter will first outline the broad, overlapping issues of the food waste

problem, and then present the different angles from which different disciplines view the problem. The next section will then examine the most common causes for household food waste, before discussing different factors that act as barriers to sustainable food waste behaviours in households.

2.1 The food waste problem

Food is a necessity for human life. As biological creatures, our relationship with food has its roots at the most fundamental level but it also permeates through our cultures, our societies, and our daily habits. Human societies spend enormous amounts of natural and economic resources on producing, transporting, storing, selling, buying, and preparing food. Yet, every year as much as thirty percent of the food produced for human consumption is lost or wasted along the global food supply chain (J. Gustavsson, 2011; Principato, 2018). This waste of food represents a waste of the resources (such as land, water, and labour) that were used to create, transport, and store the food in the first place (Schanes et al., 2018). It has been identified as a formidable challenge to the future of the world's food and agricultural systems (Principato, 2018).

As noted by Evans et al. (2013), food waste is not a new phenomenon; challenges presented by the need for the minimisation and management of household waste have been present throughout history (Evans et al., 2013). However, the rise of the global food system, increased techno-industrial food production systems and increasing urbanisation since the post war era have had a profound effect on how we obtain, treat, and think about food. Most urban residents now have less direct contact with food production than before, and must purchase it, usually from a supermarket, rather than produce it themselves (Lake et al., 2020; Sonnino, 2009; Thyberg & Tonjes, 2016)

Our new technologies and altered relationships to food now present us with new and different food waste challenges – both in terms of volume, the way it is perceived, and the way it is processed (Crocker, 2012). Increasingly since the post-war era, food waste has to a large extent become nearly invisible to many urban dwellers: food is obtained in the supermarket ready to use, and (apart from homes that have the inclination and opportunity to home compost or pass food on to animals) any waste created by the household is whisked away by the municipal service before it has a chance to become a

nuisance (Crocker, 2012; Evans et al., 2013). As urban households, by and large, interact with their food items only during the 'consumption phase', the massive amounts of resources and environmental implications that it took to produce and transport that food, and the environmental damage it may cause once it has been disposed of, is largely hidden to them – enabling an 'out of sight, out of mind' scenario where issues outside of those parameters are taken care of as 'someone else's problem' (Crocker, 2012, p. 10). Many governments, academics, and NGOs around the world widely agree that the issue of food waste is an urgent one. The issue is also very complex, and has economic, ethical, and environmental implications (Food and Agriculture Organisation of the United Nations, 2019; Schanes et al., 2018), all inextricably connected and overlapping (Närvänen et al., 2020a; Principato, 2018).

2.1.1 Environmental impacts

A food item's journey, depending on where and how it was produced, transported, and sold, may be associated with far-reaching and long-lasting environmental impacts. Many studies have shown links between agriculture, the international world food market and environmental atrocities such as deforestation, desertification, soil depletion, and the pollution of air and water (Mourad, 2016; Nellemann et al., 2009; Schanes et al., 2018; Thyberg & Tonjes, 2016). Furthermore, the environmental damage caused by food waste that is not managed in an environmentally responsible way (such as correct composting) continues long after the food itself has been discarded. In particular, food waste in landfills contributes to the production and emission of greenhouse gases (GHG) - most notably the powerful GHG methane (Bogner et al., 2007; Bolan et al., 2013). Although post-consumer waste contributes to less than five percent of total GHG emissions (Bogner et al., 2007), municipal waste disposal and treatment is now considered a significant source of anthropogenic greenhouse gas emissions (Sharma et al., 2018). If food that is produced, transported and sold in unsustainable and unjust ways have a negative impact on ecosystems and communities around the world, then the loss or waste of that food can by default be indirectly associated with the same environmental impacts (Food and Agriculture Organisation of the United Nations, 2019; Jenny Gustavsson et al., 2011). Thus, as it is linked to long-term impacts on future human generations and non-human ecosystems such as climate change, food insecurity and loss of habitat, food waste can be said to represent a serious environmental injustice.

2.1.2 Ethical implications

Food waste also represents an injustice between those in the world living in decadence and the millions going malnourished. The average amount of 220 million tonnes calculated to be wasted in developed countries every year is almost equal to the total net food production of Sub-Saharan Africa (J. Gustavsson et al., 2011). This quantity of waste can by itself be described as absurd, but it becomes even more poignant when seen in the context of world hunger and malnutrition. More than 820 million people suffered from hunger in 2018. Meanwhile, 4 million deaths globally are attributed to obesity. Despite this confounding paradox, the rates of hunger, malnutrition and obesity are all increasing (Food and Agriculture Organization of the United Nations, 2019). The subjects of world hunger, food insecurity and obesity are extremely complex and cannot be fixed through the elimination of food waste alone (Food and Agriculture Organization of the United Nations, 2019). It has even been suggested that reducing food waste may disadvantage food suppliers in poor countries since it may lower market demand (and therefore sales) (Food and Agriculture Organization of the United Nations, 2019). However, the glaring inequality between the 'haves' and the 'have-nots' in this world raises justified questions around the ethics of food waste.

2.1.3 Waste of resources and environmental debt

Since most modern households in industrialised countries need to buy the majority of their food (as opposed to being able to grow or farm it), it is obvious that food waste minimisation efforts could benefit households in a purely monetary way. For example, an estimate made by Segre and Falasconi in 2011 indicated that UK households waste an average £420 per year through food waste (Secondi et al., 2015). But food waste also costs the world in other, less obvious ways. Kummu et al. (2012) estimated that 24 percent of the world's total water resources for food production, 23 percent of global cropland, and 23 percent of global fertiliser use is used to produce the food that is lost and wasted globally (Kummu et al., 2012). In New Zealand, the average household throws out 2.84 kg of food waste per week, of which 54 percent is avoidable and 12 percent is possibly avoidable (Waste Not Consulting, 2015). When a consumer at the end of the supply chain wastes a food item – a pineapple for example - that consumer does not just waste the money it cost them to purchase the pineapple - they inadvertently also waste the water, the use of productive land, fertiliser, labour, carbon emissions, etc. that it took to produce it. The

producer at origin and the people along the supply chain may not mind this so much because they successfully sold their product and can therefore pay rent that week. However, humanity's consumption of resources is already overshooting the earth's ecological budget (Wackernagel et al., 2006) - we may ask ourselves, 'Are we, through food waste, passing on our environmental debt to future generations?'

2.2 The Food Waste Literature

Since 1980, academic interest in the subject of consumer food waste has gathered momentum and the number of food-waste related papers is growing at an increasing rate (Schanes et al., 2018). The specific field of consumer food waste *on the household level* is still modestly sized, but this field is now also receiving increasing amounts of attention (Schanes et al., 2018). As of 2015, most studies on household food waste came from the United Kingdom (Porpino et al., 2015), but international studies are catching up. The subject has been scrutinised from the angles of several different theoretical disciplines such as environmental psychology, consumer behaviour, product design, planning, and social sciences. These disciplines align along the two main strands of psychology-oriented sciences and the social practice sciences (Schanes et al., 2018).

2.2.1 The Psychology-oriented Sciences lens

Psychology-oriented approaches are often 'rooted in fields of consumer behaviour or environmental psychology' (Schanes et al., 2018, p. 980) and 'aim to single-out and measure specific intra-personal, cognitive, motivational and structural factors and processes' (Schanes et al., 2018, p. 980) that may act as either drivers or barriers to environmental behaviour. Quantitative research methods appear to be the preferred strategy employed for eliciting participants' attitudes around household food waste, which has produced large-scale data in some cases and established 'causal relationships between cognitive as well as socio-demographic variables and actions' (Schanes et al., 2018, p. 980).

2.2.2 The Social Practice theory lens

Until recently, waste has traditionally been a marginal topic for social scientists who have mostly approached it as a practical problem in need of logistical management through

environmental policy and planning. It has to a large extent been conceptualized in a two-dimensional way as the worthless stuff left over after social life has consumed what it wants in a linear process of production, consumption and disposal (Evans et al., 2013). During the past decade however, waste has increasingly become characterized as a social scientific topic for investigation rather than as a purely practical problem for policy makers (Evans et al., 2013). Through quantitative, mixed-method and empirical research methodologies, social science-oriented approaches (often evolving around social practice theory) have added valuable contribution to the food waste literature by broadening the perspective on food waste generation. This approach moves beyond individual psychological factors and acknowledges the wider 'social, economic, and cultural facets of everyday life' (Schanes et al., 2018, p. 981), thereby re-framing food waste as a societal problem rather than that of the individual consumer (Evans, 2012, 2014; Graham-Rowe et al., 2014; Schanes et al., 2018; Wansink et al., 2000).

Whether explicitly or implicitly, the question of where the responsibility lies for sustainable practices permeates both of these approaches. Psychology-oriented sciences tend to view decisions and outcomes as the responsibility of individuals (Southerton & Yates, 2014), while social practice theories, rather, account food-waste behaviour to wider social-cultural, temporal and spatial factors that individuals are entangled in through their everyday lives (Schanes et al., 2018).

Unfortunately, as noted by Närvänen et al. (2020), the literature on food waste 'remains somewhat disjointed [with the] net result … that the development of innovative and evidence-based approaches to managing food waste has been painfully slow' (Närvänen et al., 2020a, p. vi). Nevertheless, in spite of its internal tensions, there is agreement in the literature that the problem of domestic consumer food waste is complex and multi-layered, and 'debate is firmly rooted in attempts to render today's "normal ways of life" more efficient and less wasteful' (Southerton & Yates, 2014, p. 133). There is also growing acknowledgement that this multi-faceted problem requires a holistic, inter-disciplinary and inter-industry approach; there is no silver food waste bullet.

2.2.3 Conceptualizing waste in new ways

In line with an 'increasing political and scientific consensus about the need to reduce global food waste' (Närvänen et al., 2020a, p. 1), a growing faction of planning theory has in recent years been pulling in new directions how food waste is conceptualized, many now abandoning the view of waste as a material left over from a linear process, and instead leaning toward circular conceptual models and whole-system approaches.

The Circular Economy is a well-known emerging sustainability concept that has already been adopted by several governments in the world, including the European Union (EU) and New Zealand (Cavaleiro de Ferreira & Fuso-Nerini, 2019; Ministry for the Environment, 2020c). The Circular Economy is commonly understood as a system with a holistic impact that works in loops, at different levels, which mimic the loops seen in nature. At its core there is the design for second usage, the goal to eliminate waste and to avoid toxic materials, the importance of waste management, and the implementation of the 9Rs (reduce, reuse, recycle, recover, refuse, repair, refurbish, remanufacture, and repurpose) (Cavaleiro de Ferreira & Fuso-Nerini, 2019, p. 1). The nature of food's materiality is such that waste will never be eliminated completely. But by changing the way that organic waste is regarded, cities have the option of seeing it as an opportunity; by abandoning outdated 'linear' supply chain models and incorporating food waste into a closed-cycle urban ecology and circular economy, cities can reduce greenhouse emissions while achieving material gains (Lehmann, 2012). A simplified version of the circular economy concept with food in focus is depicted in Figure 2.1, imagining organic by-products of food and food production to be a resource rather than a waste product.

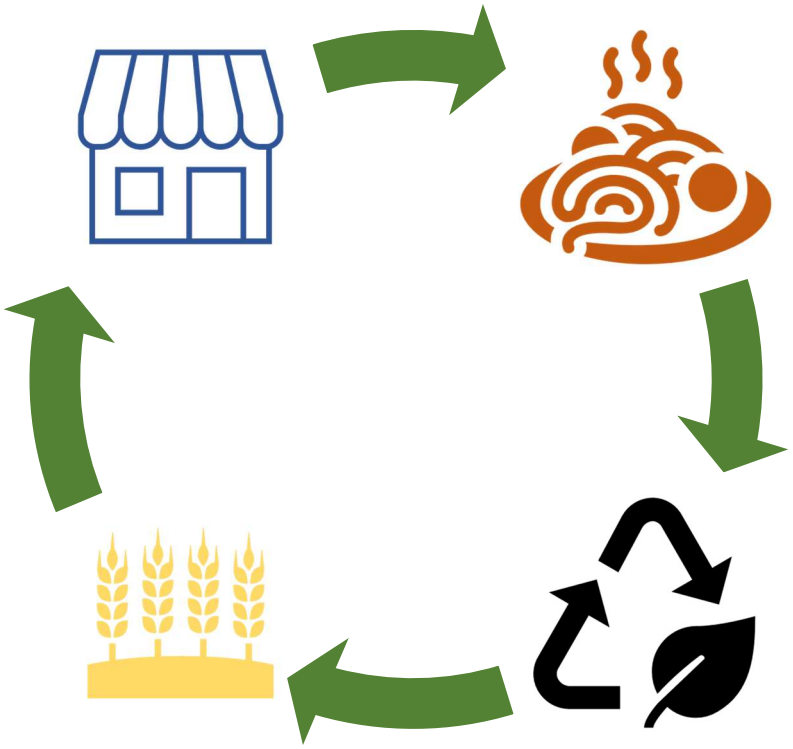

Figure 2.1: Simplified depiction of the circular economy

Another very well used concept to further sustainability is the Waste Hierarchy. The Waste Hierarchy was first defined in the European Parliament Council's Community Strategy for Waste Management in 1989, and has since been adopted worldwide (Papargyropoulou et al., 2014). The aim of the Waste Hierarchy is to 'identify the options most likely to deliver the best overall environmental outcome' (Papargyropoulou et al., 2014, p. 110) by favouring 'prevention' and leaving 'disposal' as the least desirable outcome. Papargyropoulou et al. (2014) note that 'sustainable resource and waste management is relevant to the whole life cycle of products and services' (p.111), not just to the consumption stage of a product's life. Based on the Waste Hierarchy and firmly rooted in the United Nations Environmental Program's definition of Sustainable Consumption and Production, Papargyropoulou et al. (2014) proposed the Food Waste Hierarchy promoting a 'fundamental re-think of the current practices and systems in place' (Papargyropoulou et al., 2014, p. 106). The Food Waste Hierarchy (depicted in Figure 2.2) offers a holistic approach to food waste issues by considering environmental, economic, and social realms while prioritizing options for waste minimisation and management throughout the supply chain.

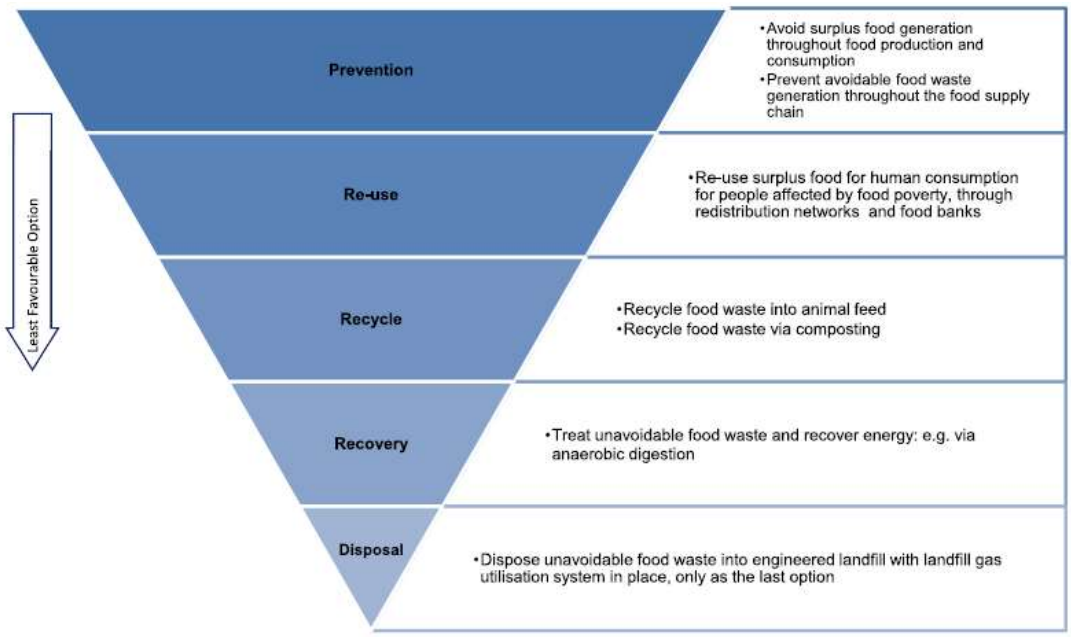

Figure 2.2: The Food Waste Hierarchy. Source: Papargyropoulou et al. (2014)

The food waste hierarchy makes it obvious that to achieve a closed loop management system in which resources are maximised and kept in use for as long as possible, waste should be avoided.

With the burgeoning conceptualisation of food waste as an issue that is infiltrated throughout human activities worldwide, there is growing acknowledgement that food waste would be correctly classified as a 'wicked problem'. A wicked problem is a concept often used in planning and policy contexts to define multi-faceted problems that are 'unstructured, cross-cutting and relentless' (Närvänen et al., 2020a, p. 2). By placing food waste within a wicked problem conceptual framework, the orientation of solutions and policy efforts should flow more logically towards a holistic, inter-disciplinary and inter-industry approach. Närvänen et al. (2020) have developed a useful model in this context which illustrates the shared responsibility of all actors at multiple levels from everyday life to policy level (see Figure 2.3). Lake et al. (2020) explains that a 'wicked problems framework of food waste allows us to understand that the ineffectiveness of past outreach and education efforts are related to:

1. the resistance of dominant institutional, economic, political and supply-chain systems;

2. the Western cultural perception of food and land as innate and abundant commodities rather than as integral component of communities; and

3. the failure to consider food waste in context with underlying social and cultural factors, leaving it to be dealt with by short-sighted solutions.

(Lake et al., 2020, pp. 197–198).

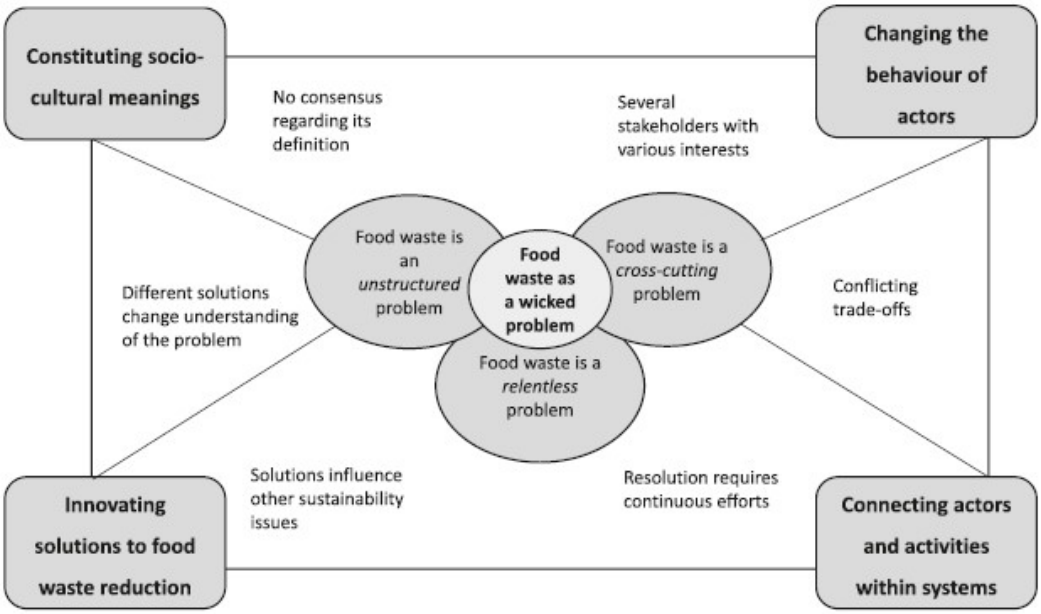

Figure 2.3: Framework for solving the wicked problem of food waste. Source: Närvänen et al., 2020, p.6.

Left unchecked, amounts of solid waste will continue to grow in line with the constant increase of the world's consumption patterns. Urban planning can play a pivotal role in the development of circular economies (Ministry for the Environment, 2020c) and 'intelligent circular metabolisms for retrofitting districts, and waste collection and treatment systems that will eliminate the need for landfills' (Lehmann, 2012, p. 317).

2.3 Food waste policy

Insightful and well-informed planning and management of urban settlements can help to provide sustainable outcomes in economic, societal, and environmental dimensions.

Conversely, inefficient land use, pollution and environmental degradation, allowed through inadequate planning, unsustainable production and consumption patterns, can impair a city's sustainability (United Nations, Department of Economic and Social Affairs, Population Division, 2019). This section will survey various international policy approaches to food waste. For lists of additional policies and initiatives compiled by Secondi et al. (2015) and Principato (2018), see Appendices B and C.

2.3.1 International policies

The United Nation's Sustainable Development Goal 11 is a commitment to making cities inclusive, safe, resilient, and sustainable, and participatory planning can play an important role in its implementation. Sustainable Development goal 12.3 is to 'halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including postharvest losses" by 2030 (United Nations, 2015). In line with these goals, food waste is increasingly finding its way onto the agendas of NGOs, businesses and governments around the world (Mirosa, 2019; Principato, 2018; Secondi et al., 2015). For example, in September 2015, the U.S. Department of Agriculture (USDA) and the U.S. Environmental Protection Agency (EPA) announced a food loss and waste reduction goal of 50 percent for the United States by 2030 (US EPA, 2016). In 2016, the French senate unanimously passed a law that banned large supermarkets from throwing away or destroying unsold food, forcing them to redistribute the food instead (Principato, 2018). In 2018, the European Union released the Circular Economy Package, which included four waste-specific directives. The overall goal of the Circular Economy Package is to improve EU waste management by implementing the concept of the Waste Hierarchy. The Waste Hierarchy 'sets a priority order for all waste prevention and management legislation and policy which should make any disposal of waste a solution the last resort: prevention, preparing for re-use, recycling, other recovery, energy recovery, and disposal' (Latham & Watkins LLP, 2018).

Through the Circular Economy Package, the EU has solidified Europe's leading position in waste management (Latham & Watkins LLP, 2018). It also signals a shift in thinking among politicians, scientists, and planners towards a more collaborative and inclusive outlook and an understanding that narrowly focussed measures are not likely to produce

sustained or wide-reaching results. A part of this package, the Waste Framework Directive 2018/851 (an amendment to the 2008 Waste Framework Directive) requires Member States to improve their waste management systems. Article 31 of that directive calls for Member States to aim for a 50 % reduction target by 2030. While having regard to the environmental, social and economic benefits of preventing food waste, 'Member States should establish specific food waste prevention measures, including awareness campaigns to demonstrate how to prevent food waste, in their waste prevention programmes' (Directive (EU) 2018/851, 2018). Furthermore, Article 32 of that directive requires Member States to 'provide incentives for the collection of unsold food products at all stages of the food supply chain and for their safe redistribution, including to charitable organisations. Consumer awareness of the meaning of 'use-by' and 'best-before' dates should also be improved in order to reduce food waste' (Directive (EU) 2018/851, 2018). ECOWASTE4FOOD is an interesting EU funded project that flows from these new EU agendas of waste management, the circular economy, innovation, and social inclusion. The project aims at enabling 'local and regional authorities to exchange their experiences in promoting good practices and in planning city/regional strategies, so as to promote innovative solutions that contribute to prevent and to reduce food waste in their territories' (Féret, 2020, p. 389).

New Zealand has fallen behind several other developed nations by not having an up-to-date national food waste reduction strategy or target. However, a briefing report on New Zealand's food problem has recently been released by the parliamentary Environment Committee (Department of Food Science, 2020; Mirosa, 2019; Webb, 2020). Further details on that report will be presented in Chapter 4, 'Dunedin Context and Related Policies'.

2.3.2 Local governance

Activity related to food security and food waste is also increasing at local levels in many countries. In response to facing enormous food security and sustainability challenges, a growing number of municipal governments around the world (for example, London, New York, and Dar es Salaam) are implementing integrated food policies – so as to improve

access to fresh, healthy food at the local level, improve linkages with their surrounding regions, and enable and encourage urban agriculture (Sonnino, 2009).

Many cities now subscribe to the principles of Zero Waste (Zero Waste Cities, 2020), which include waste minimisation goals for food waste. Some have developed strong policies to divert food waste from landfills and to regulate the processing of food waste, such as composting or conversion to biogas. For example, as part of the City of Stockholm's environmental goals for Hammarby Sjöstad (a unique and high-profile environmental project, or 'green district'), waste is 'thoroughly sorted in practical systems, with material and energy recycling maximised wherever possible' (Fränne, 2007, p. 8). Separation and processing of food waste is included in this highly efficient, underground waste disposal and transport system. From 2005 to 2010 recycling rates increased, achieving 90 % diversion from landfill (Lehmann, 2012).

It may be tempting to applaud waste policies that lead to such positive results and decide that the problem has been dealt with. Indeed, measures such as policy change, educational reforms, and technological solutions serve as important leverage points in the work towards sustainable waste management. As observed by Lake et al. (2020) however, they are ineffective in the long run if applied as standalone interventions. Many attempts to address the food waste issue 'fail to get at unconscious influences, habitual behaviours, cultural ethos, or infrastructural momentum driving the situation' (Lake et al., 2020, p. 195). Quested et al. (2013) make the important observation that food waste generation is not a single, stand-alone behaviour but rather the delayed 'result of multiple behaviours that can increase the likelihood or amount of food being wasted' … [By] the time an item of food is thrown away, the opportunity to prevent that food from becoming waste has usually passed, i.e., the action (or actions) leading to the waste may have occurred some time, often many days, in the past' (Quested et al., 2013, p. 44). When considering that these food-related behaviours are in turn influenced by the complex 'lasagne' of cultural, social, economic, and physical layers that the household members are situated in, it becomes clear that multi-pronged and long-term measures are needed to address the issue from all angles and not just at the end of the long process it took for the food to end up as a wasted resource.

Another measure that is frequently called for in the fight against food waste is educational campaigns to target either consumers or workers in the food system industry, or both. The use of narrowly focused educational campaigns without the back-up of any other measures have been criticized for being 'fairly ineffective because they do not address the social and cultural drivers of waste' (Lake et al., 2020, p. 195). Evans (2014) argues that educational campaigns assume individuals to be 'autonomous architects' (p.17) of their food-related behaviours, failing to 'take account of the unique realities involved across a wide range of contexts' (Lake et al., 2020, p. 195), ethical complexities and a comprehensive, long-term view (Evans, 2014; Lake et al., 2020).

A focus on techno-scientific interventions and narrowly framed policy change at the expense of deeper, more far-reaching questioning of why the problem occurs in the first place has been criticized by scholars to only be dealing with the symptom of the problem (the discarded food at the end of the 'pipe'), and not the cause(s) of it, resulting in simply moving the food waste from one place to another rather than alleviating it (Evans, 2014). Evans (2014) insightfully illustrates how food industry practices (such as making food available in excessive quantities) in effect passes the 'burden of surplus' (p. 96) onto consumers. That concept can be taken one step further if we imagine that the same 'burden of surplus' is discarded by households into municipal food waste bins, to be whisked away by a refuse truck and, to the relief of the environmentally conscious householder, processed into either compost or biofuel at the plant. It could be argued that the more successful a waste management system is at removing the symptom of the problem, the more it fails at actually addressing the cause of it. Could such systems, reliant on 'technosalvation' (Lake et al., 2020, p. 193) to allow us to continue with the status quo, be described as 'successful failures' (Connelly, 2017; Seibel, 1996)?

2.3.3 Governance engagement by civil society

Many local governments still devolve the task of dealing with food waste to 'non-state actors at the community, household or individual level' (Warshawsky, 2015, p. 28) in a rather *ad hoc* way (Principato, 2018; Warshawsky, 2015). Many places have seen a groundswell of activity from civil society, motivated by their concern for food security, urban sustainability, and the desire for a healthy local food system. This civil activity often strives to influence local food system governance and can take a variety of forms,

from ‘multi-stakeholderism to co-governance to polycentrism/self-governance’ (Andrée et al., 2019, p. 4; Principato, 2018).

A prominent form of such governance engagement has in many places been the establishment of food policy councils (also known as local food groups or local food networks). These councils often serve as an interface between community groups and local politicians, often succeeding in placing food ‘at the heart of municipal policy making’ (Principato, 2018; Sonnino, 2009, p. 432). Some local food councils, such as the Toronto Food Policy Council (Toronto Food Policy Council, 2020), have identified food waste as an important issue, and are actively working to raise awareness, disseminate information and support initiatives that result in food waste reduction - such as local food redistribution programmes, social supermarkets and food banks (Michelini et al., 2018; Närvänen et al., 2020b).

The Waste and Resources Action Programme (WRAP) is a good example of how organisations such as local food councils can play an important role in the fight against food waste. Set up in the United Kingdom (UK) in 2000, WRAP is a charitable community group that has had remarkable success in raising awareness about food waste and related issues. WRAP brokers sector-wide agreements, advocates for change and brings diverse organisations together over the common goal of reducing food waste. The literature on food waste recognises the potential power of such public-private collaboration, and often encourages further research on the subject (Halloran et al., 2014; Mackay, 2016; Mackay & Connelly, 2019; Principato, 2018; Secondi et al., 2015). Through kerbside waste audits and other research the organisation has established an important baseline of quantitative data for subsequent researchers to draw on, and through their consumer campaign Love Food Hate Waste (LFHW) they are now able to reach consumer audiences internationally, to inform and encourage more sustainable food practices (WRAP, 2015). WRAP also initiated and brokered the Courtauld Commitment in 2005. This was the first in four consecutive, voluntary agreements involving WRAP, government agencies and corporate food system players where the signatories agreed to the objectives of reducing waste and emissions related to food and food packaging (WRAP, 2015). The UK can now boast an 18 % reduction of household food waste since 2007, and this has to a large degree been accredited to WRAP’s engagement (WRAP, 2020). By acting

as an interface between local government agencies and household consumers at a 'grass root level', they have shown how local community action can give communities and individuals a voice and deliver results that make a difference.

Also in New Zealand is an increasing number of alternative food networks (AFN) and initiatives being formed – mostly in response to a perceived need for more sustainable food consumption practices and a concern over the decline of the state of the land, food insecurity and food waste and sustainability in general. These AFNs often engage in consumer education, behavioural change (such as buy local campaigns), community cooperation (such as community gardens and farmers' markets) and local government engagement (Mackay, 2016; Mackay & Connelly, 2019; Mirosa, 2019; Savarese et al., 2020). Although most AFNs in New Zealand work at the local level rather than in a nationally concerted effort, many of them are having a positive impact. A very good example is KiwiHarvest, a food rescue organisation that, by developing strong networks between local businesses, the community, and local government, has been successful in diverting perfectly good food from the waste stream while simultaneously providing food to people who appreciate it (Mackay & Connelly, 2019).

Given the wicked nature of food waste, it is widely acknowledged that it will never be fully solved. Narrowly framed interventions to tackle the problem fail to grapple with the full extent of the issue and may even exacerbate it. There is now growing consensus among planners, policy makers and scientists that the responsibility for addressing food waste is shared by government, industry, society, and individuals. Is it time for a radical shift in thinking about how modern domestic life is structured (Evans, 2014; Southerton & Yates, 2014)? Rethinking food waste problems and solutions may offer an opportunity to do so.

2.4 What is food loss and food waste?

There are several different stages in the 'food loss journey' (Principato, 2018), from the place of harvest to where the food is processed, transported, stored, sold and eventually (not) eaten and discarded. To aid conceptual thinking and policy making, the United Nations Food and Agriculture Organisation (FAO) has created a conceptual framework

where ‘food loss and waste is understood as the decrease in quantity or quality of food along the food supply chain’ (Food and Agriculture Organisation of the United Nations, 2019). According to this framework, food loss is the result of decisions made by suppliers in all stages of the food supply chain up to, but excluding, the point of interaction with the final consumer. Food waste is then the result of decisions made by actors remaining at the end of the food supply chain: consumers, retailers and food service providers (Food and Agriculture Organisation of the United Nations, 2019). In practical terms it can be difficult to separate ‘food loss’ from ‘food waste’ depending on where in the supply chain one is focusing, and it could be argued that FAO’s conceptual framework may be an oversimplification of the real-life picture. However, from a policy point of view, ‘the distinction between food loss and food waste is highly relevant, as the types of interventions that can affect consumer behaviour (food demand) are different from those that encourage suppliers to reduce food losses (food supply)’ (Food and Agriculture Organisation of the United Nations, 2019, p. 5). This thesis will be concentrating on food waste at the consumer level.

Due to a lack of financial, technical and managerial resources, food loss occurs mainly during the earlier stages of the food supply chain in developing countries (Secondi et al., 2015). In developed countries, 30-40 percent of the entire food waste and loss volumes occur at the consumption phase (Principato, 2018). It is widely known that vast volumes of food are wasted in supermarkets, restaurants, and other places where food is provided to consumers on a daily basis. But it does not stop in the shop; household waste audits carried out in the UK and New Zealand (amongst other countries) show that food waste makes up approximately one third of all household waste collected at the kerbside and destined for the landfill. As such, private households represent the largest food-waste faction along the food supply chain (Schanes et al., 2018; WasteMINZ, 2018; WRAP, 2020).

2.4.1 Avoidable vs unavoidable food waste

The discussion on food waste at consumer level includes the important distinction between avoidable, possibly avoidable and unavoidable food waste (Papargyropoulou et al., 2014). Fully edible food that is thrown out simply because it is not desired or has ‘gone off’ is classed as avoidable. Food items that are technically edible but that are more

difficult to prepare or make edible (e.g., pumpkin seeds or potato skins) are classed as possibly avoidable. Finally, items that are not edible to humans, but are still part of the food we buy and consume, such as bones and orange peel, are classed as unavoidable. For the purposes of this study, food waste minimisation will be seen in relation to avoidable and possibly avoidable food waste. Of course, households could choose to follow diets that eliminate unavoidable food waste items. However, such choices may implicate lifestyle changes which are outside the scope of this study.

2.4.2 Food waste minimisation vs food waste management

The distinction between food waste minimisation and food waste management is one that will be important for this study but one that is sometimes a little blurred in the literature. Leading up to the point of which the perception of a food item changes from 'food' to 'waste', any given household would have encountered several points in that item's 'waste journey' (Principato, 2018) when they could have had the opportunity to prevent it from going to waste at all. Decisions made during planning, shopping, storing, cooking, and eating all have the potential to minimise the chances for food to be wasted along the way (Quested et al., 2013). Once a household has made the decision that a food item is to be discarded, the item's journey continues into the realm of waste management.

From a resource management perspective, the different available methods for managing food waste at home (such as home composting, worm farming, bokashi, etc.) are good options to use for diverting domestic food waste from landfill. However, those methods require appropriate space, time, skills, and inclination for households to be able to engage in. Many households in medium and high-density urban settings, lack some or all of those attributes, making the waste disposal services the only choice available for the management of their unavoidable food waste.

Waste collection and management is, of course, an essential service to any human settlement, and it is imperative for that waste to be managed by sustainable methods if a circular economy is to be achieved. However, even if discarded food is recycled into valuable products via efficient facilities and reincorporated into the economy, that process would still not undo the social and economic inequality, the environmental

pollution and the consumption of resources it took to produce, harvest, package, transport, store, market and sell the discarded and wasted food. As stated by Schanes et al. (2018), 'if food is wasted by households at the end of the supply chain, all (fossil) energy (and greenhouse gas emissions) put into its production, processing, transportation, cooling and preparation [would be] in vain' (Schanes et al., 2018, p. 978). Sustainable municipal food waste management practices are absolutely important and necessary, but will to a large degree remain the a symptom of a 'wicked problem' (Närvänen et al., 2020a) if it does not close the circle and also tackle the much less tangible beast of waste minimisation.

Although it can be helpful for conceptual thinking to categorise food waste according to where in the food waste journey it occurs, the problem is far from two-dimensional and must be observed from many different angles. The 'food waste iceberg' (Food and Agriculture Organisation of the United Nations, 2016) will not melt away by handing out the blame for it on the consumer alone (Evans, 2011, 2014), nor will an over-reliance on city planning and technology magically make it disappear. In order to grapple with the over-arching food-waste related issues mentioned above, deeper societal questions need to be asked: if we already acknowledge and understand that food waste is such an important issue, why does it happen in the first place?

2.5 Agreed causes of domestic food waste

Evidence of the causes of food waste and the barriers to its reduction remain somewhat scattered (Schanes et al., 2018, p. 979), but there is widespread agreement that all practical stages of domestic food-related practices and routines have the potential to be a point at which food is wasted. From the time a meal is conceived and planned and all the way through the stages of buying, storing, cooking, portioning and eating, there are points of opportunities for households to cause good food (and therefore also money, time, emissions, etc.) to be wasted (Principato, 2018; Quested et al., 2013; Schanes et al., 2018). By default, these are therefore also intersections in the household meal-making process where the waste of food can be *prevented.*

As social scientists are now challenging the concept that decision-making on the individual level alone is to blame for the waste of food (Evans, 2011), more complex and less tangible social truths are being problematized and investigated as causes or barriers to good practice (Quested et al., 2013). The two spheres of causation are intimately interlinked; separating the practical, or 'hard' causes from 'soft' sociocultural barriers may be a gross oversimplification, but for the purposes of clarity we will examine them separately in this section.

2.5.1 Practical factors: shopping, planning, and cooking

2.5.1.1 Shopping and planning

For most urban households in developed countries, food for meal creation in the home is acquired through shopping. Alternative shopping methods and alternative food networks, such as online shopping directly from suppliers, farmers' markets, food banks etc., are increasing in popularity (Connelly et al., 2011; Food and Agriculture Organisation of the United Nations, 2019) but supermarkets are still the largest source of food for most urban households. Shopping is a stage in a household's meal making process that holds significant potential for the genesis of household food waste.

Supermarket shopping offers many distractions and temptations that can lead to overbuying and impulse buying. Marketing tools such as 'buy one, get one free' or packaging that is too large for small households have been linked to as much as 20-25 % of food waste (Evans, 2011; Graham-Rowe et al., 2014; Schanes et al., 2018). The specific placement of products on shelves and even the type of music played in the store can cause households to buy more than they first intended. Likewise, distractions such as tired children, the time of day, whether the shopper is hungry, etc can also have an impact on what is bought and what is not (Gifford, 2014).

Interestingly, Graham-Rowe et al. (2014) identified among household purchasers a perception that private households are exempt from responsibility for the food they waste due to over-sized packaging, in-store marketing techniques and low-quality produce that has become a norm within the supermarket culture in many places, effectively shifting

the blame on to the modern food system rather their own actions. While it is indeed possible that the food industry deserves their fair share of the blame for why so much food is ultimately wasted, Graham-Rowe et al. (2014) identified this perception as a barrier to food waste minimisation on the part of the consumer. It is important here to recall Evans's (2011) analysis which indicates that 'food waste arises as a consequence of households negotiating the contingencies of everyday life' (p.438) and that it is overly simplistic to blame consumers for food waste-related problems or expect individuals to solve them alone (Evans, 2011). The difference between Evans' and Graham-Rowe et al.'s arguments illustrates the nuanced way in which blame and responsibility is sometimes assigned within the literature.

It is widely agreed that careful pre-shopping planning activities such as writing weekly menus and grocery lists, setting a budget and even organising lists according to the supermarket's layout can prevent impulse-buying and buying larger-than-needed quantities, thereby also preventing food waste to occur further down the line (Jenny Gustavsson et al., 2011; Secondi et al., 2015). Planning ahead for meals, shopping and leftover cuisine can in this way prevent household food waste, save money, and even save time through improved efficiencies in the meal-making process (Love Food Hate Waste New Zealand, 2020).

2.5.1.2 Storing

Once food has been acquired and brought home, it needs to be stored before being cooked or assembled for meals. Food storage may seem like too mundane a concept to have much impact on the volumes of food wasted, but as shown by Farr-Wharton et al. (2014), many households lack full awareness and storage management procedures to achieve the longevity potential of the food and ingredients they have bought. Encountering a 'lost in-the-back-of-the-fridge' scenario is a situation many people are no doubt familiar with when re-discovering expired food that was simply forgotten. Confusion around the meaning of use-by and best-by labelling, combined with a fear of food poisoning and lack of skill to assess edibility, fall into the same category (Moreno, 2019). A consequence of this lack of good food storage management habits is that both expired

and still edible food is discarded from households and therefore wasted (Farr-Wharton et al., 2014).

A common hypothesis is that heightened skill and awareness levels would act as a remedy to food waste caused by confusion around food storage and edibility. However, there is some disagreement around this. Some studies show that systematic food storage habits such as good categorizing and frequent re-stacking or re-ordering can have a minimising impact on food waste generation in the home (Farr-Wharton et al., 2014; Schanes et al., 2018), although a quantitative study in 2016 by Visschers et al found that knowledge about use-by dates and storing may only have indirect effects on food waste intentions and behaviours (Visschers et al., 2016).

2.5.1.3 Cooking and portioning

The literature reveals that domestic cooking skills, cooking practices and portioning habits have a direct causal effect on the amount of food wasted in the home. The most prevalent practice in this regard is the habit of preparing and portioning more than required, often leading to uneaten food being binned (Graham-Rowe et al., 2014; Porpino et al., 2015). Other sources of cooking-related food waste have been shown to occur in homes with children, where prepared meals are not eaten for different reasons, such as not being home at meal time, differing eating patterns, and differing preferences (Evans, 2011; Schanes et al., 2018).

Portion control and enhanced cooking skills (enhancing the ability to incorporate leftovers into meals and also base cooking on what is already in the larder) are two measures that have been identified as effective waste prevention strategies (Graham-Rowe et al., 2014; Secondi et al., 2015; Watson & Meah, 2012). Evidence suggests that the households that rely heavily on takeaways or convenience foods throw away more food per unit than in households where higher levels of home cooking occurs (Evans, 2014; Mallinson et al., 2016). Could this be supporting the argument that cooking skills and portion control have a direct causal effect on reducing the generation of domestic food waste? Even if that were the case, it is important to acknowledge here that for every single modern household to acquire the time and skills and motivation required for the

specific purpose of minimising food waste would be unfeasible without meaningful changes to current spatial, systemic, and value-based changes.

2.5.2 Socio-cultural factors: routines, economics and demographics

2.5.2.1 Routines

As shown above, a lack of cooking skills in households has been shown as a potential antecedent to household food waste. This barrier to 'food waste cooking' (Schanes et al., 2018, p. 984) may also be linked to spatial-temporal barriers since leftovers require storage space and potentially also preparation time (Evans, 2012; Farr-Wharton et al., 2014).

Paradoxically, habits of abundant cooking and purchasing have also been identified as barriers to food minimisation practices. Some householders and parents feel a strong drive to be a good provider for family or guests. This drive can lead to habitual over-buying and preparing more food than the household can or will consume, ultimately leading to food being wasted – either after being prepared or going 'off' while sitting in the fridge waiting to be cooked (Evans, 2011, 2012; Graham-Rowe et al., 2014; Porpino et al., 2015).

2.5.2.2 Minimising inconvenience

Buying in bulk or in excess has also been linked to a desire to avoid inconvenience (Graham-Rowe et al., 2014). Buying in bulk is practiced by some households as a way of economising their time (Graham-Rowe et al., 2014) as well as money (Porpino et al., 2015). As shown by Porpino et al. (2015), this practice, however well intended, can lead to an opposite effect, ultimately leading to food loss: bulk buying seems to 'underpin over-preparing, which in turn tends to generate more food waste. It can be supposed, therefore, that food waste nullifies the efforts to save financial resources at the time of purchase' (Porpino et al., 2015, p. 623). Minimising inconvenience as a potential barrier to food minimisation has also been linked to the massive rise in popularity of convenience food (Graham-Rowe et al., 2014) – the use of which, as mentioned earlier, is associated with higher levels of domestic food waste.

2.5.2.3 Socio-economic status

The effect of socio-economic status on food waste quantities also throw up conflicting results. Some studies have found that households with high levels of income waste more than poorer households (Engström & Carlsson-Kanyama, 2004; Koivupuro et al., 2012; Secondi et al., 2015; WRAP, 2020) or are less likely to change their behaviour towards food waste (Principato, 2018). However, a Brazilian study on food disposal in low-income families completed by Porpino et al. (2015) showed a marked propensity for high levels of food wastage also at that socio-economic level. Although this food waste appeared to be linked to other socio-cultural factors such as the lack of food storage knowledge and the 'good mother identity' (linking back to Graham-Howe et al.'s (2014) study previously mentioned), it challenges 'the notion that food waste is a prevalent issue only in higher-income families' (Porpino et al., 2015, p. 623). Previous research had not been able to confirm any correlation between income and food waste (Secondi et al., 2015). Widely differing results on the effects of household economic levels warrant further research into the subject. Secondi et al.'s (2015) multilevel analysis on European households' food waste behaviour was one of the first to highlight an association between low levels of education and high levels of food wastage. It has been suggested that these results can be explained 'by the fact that people with a higher level of education are more likely to have higher incomes' (Secondi et al., 2015, p. 38) and that they should therefore be seen in connection with food waste habits of households with higher socio-economic status. Further research is required for this to be confirmed.

2.5.2.4 Age and gender

Studies have been done on whether socio-demographic factors provide any predisposition for households to be high or low wasters of food. As observed by Schanes et al. (2018), the empirical evidence emerging from these studies is far from clear although some studies suggest that a combination of different socio-demographic factors may have been assigned some predictive power.

Some studies have found that women waste more food than men do, although Barr (2007) have concluded that women are more likely to reduce food waste than men are – a suggestion offered to explain this is that women may have a higher awareness of the cost

to the household that waste brings due to the likelihood that they may spend more time cooking (Secondi et al., 2015).

Results vary among studies whether age is a determining factor on the level of engagement with environmental issues (Schanes et al., 2018). Likewise, the influence of consumers' age on levels of food waste has been a subject of debate in the literature (Secondi et al., 2015). However, most researchers seem to agree that younger people generate more food waste than older people (especially people over 65) do (Hamilton et al., 2005; Quested et al., 2013; Secondi et al., 2015, 2015; Tucker & Farrelly, 2016b). Explanations offered as to the reasons why older people waste less range from having lived through hardship or war (Tucker & Farrelly, 2016b) to simply being more careful with their spending (Hamilton et al., 2005). Large households and households with young children have been identified as the highest wasters (Hamilton et al., 2005; Tucker & Farrelly, 2016b; WasteMINZ, 2018), attributed to the often unpredictable 'behaviours and preferences of kids and teenagers' (Jörissen et al., 2015, p. 2706).

Young adults aged 18-24 and young professionals have also been identified by some researchers as high 'offenders' when it comes to food waste (Hamilton et al., 2005; WRAP, 2020). The reasons why this demographic group waste so much are still unclear although a 2016 study by Tucker and Farrelly (2016) showed that participants aged 18-24 'appeared the least concerned overall' (Tucker & Farrelly, 2016b, p. 692) about their household's environmental impact.

Hamilton et al. (2005) pose an important observation:

> *Is the greater propensity to engage in wasteful consumption among young adults due to their particular stage of life or does it reflect a historical shift away from frugality towards profligacy? If it is the former then we would expect these young people to become more prudent as they age. If it is the latter then they will carry their profligacy through their lives thus reinforcing the inclination to waste more as the nation becomes wealthier* (Hamilton et al., 2005, p. viii).

Taking a social systems approach in their study on the capacity of Australian urban households to live sustainably, Skinner et al. (2012) determined that 'it is interaction between the contexts of everyday life – work, home and community – and the broader factors of life stage, space, time and power, that constructs both the willingness and the capacity to live sustainably' (Skinner et al., 2012, p. 38). In a case study involving adolescents living at home, Skinner et al. (2012) established that those youths who experienced negative constraints around the universal factors of time, space, and a sense of empowerment or voice (intersecting the domains of home, school, community and (parents') work) struggled to 'internalize and act on their pro-environmental attitudes' (Skinner et al., 2012, p. 42). They point out the importance of paying attention to young people in this context, as they are 'being socialized into our future as workers, consumers, policymakers and "agents of change" (Skinner et al., 2012, p. 38). This notion has been reverberated by Principato et al. (2015) and Secondi et al. (2015): youths are a 'target population who require the most attention' (Secondi et al., 2015, p. 28).

2.6 Barriers to sustainable domestic food waste practices

It would be unrealistic to expect 100 % elimination of food waste through minimisation alone – especially for non-avoidable food waste. It is therefore important for waste management systems to include channels for food waste that citizens have not been able to avoid. Through a general look at the multi-disciplinary body of literature on consumer food waste, broad categories of barriers to the use of sustainable food waste management methods emerge. The categories are inter-related and layered, and often overlap with the causes of domestic food waste (examined above). The following section will examine a selection of these categories.

2.6.1 The Value-action gap / the Attitude-behaviour gap

Most people agree that food waste should be avoided, and that unavoidable food waste should be managed in a sustainable way (Evans, 2011; Porpino et al., 2015). So why do we still throw out such vast amounts of food every year? The answer to that question is extremely complex, fluid, and not yet fully defined. Numerous studies have been completed and many theoretical frameworks have been developed by environmental

psychologists and social scientists over the last 30 years to explain the evident gap between environmental knowledge and awareness, and pro-environmental behaviour. This phenomenon is sometimes referred to as the value-action gap or attitude-behaviour gap (Kollmuss & Agyeman, 2002; Schanes et al., 2018). As observed by Kollmuss & Agyeman (2002), no definitive explanation has yet been agreed upon; 'what shapes pro-environmental behaviour is such a complex one that it cannot be visualized through one single framework or diagram' (Kollmuss & Agyeman, 2002, p. 239). Environmental behaviours related to consumption and waste have been observed to be determined by the structures of daily life (Skinner et al., 2012).

Early models of pro-environmental behaviour from the early 1970s were based on the theory that the progression to pro-environmental behaviour was simple and linear: increased environmental knowledge would lead to environmental awareness and concern, which then would logically manifest in pro-environmental behaviour. Research has since shown that these types of models, which rely heavily on information to be the driver of change, are largely unsuccessful. Behaviour and behaviour change are subject to varying determinants on several different levels which are too complex, interconnected and fluid to be magically erased through the application of information alone. In fact, most researchers 'agree that only a small fraction of pro-environmental behaviour can be directly linked to environmental knowledge and environmental awareness' (Kollmuss & Agyeman, 2002, p. 250). Theories align along different theoretical streams such as: Early US Linear Models, Altruism, Empathy, and Prosocial Behaviour Models, and Sociological Models, Economic Models, and Social Marketing Models. The lively debate within the interdisciplinary literature on this subject show disagreements on research methodologies as well as which factors are most influential. However, as noted by Kollmuss & Agyeman (2002), some factors are agreed upon. These factors can be classified into groups of Demographic Factors (age/gender), External Factors (Institutional, Economic, Social and Cultural), and Internal Factors (Motivation, Values, Environmental Knowledge, Attitudes, Environmental Awareness, Emotional Involvement, Responsibility, Priority, and Locus of Control).

Blake's 1999 model 'the Value-action gap' represented a new body of literature that had been developing rapidly and which had been 'informed by broader social scientific

theory' (Blake, 1999, p. 10) as opposed to purely psychological theory (Kollmuss & Agyeman, 2002). Blake made the important point that earlier pro-environmental behaviour models had failed to consider individual, social, and institutional constraints as barriers to action. With his barrier classification of Responsibility, however, Blake does align closely to the psychologist's notions of 'locus of control' - a recurrent concept in the literature that 'represents an individual's perception of whether he or she has the ability to bring about change through his or her own behaviour' (Kollmuss & Agyeman, 2002, p. 243). Blake's theory has been criticized for not going into enough depth on the psychological side of things and also for not including social factors or cultural norms into his barriers (Kollmuss & Agyeman, 2002). However, the main thrust of his model (see figure 2.4 below) will serve well as a theoretical framework for this thesis to be based upon.

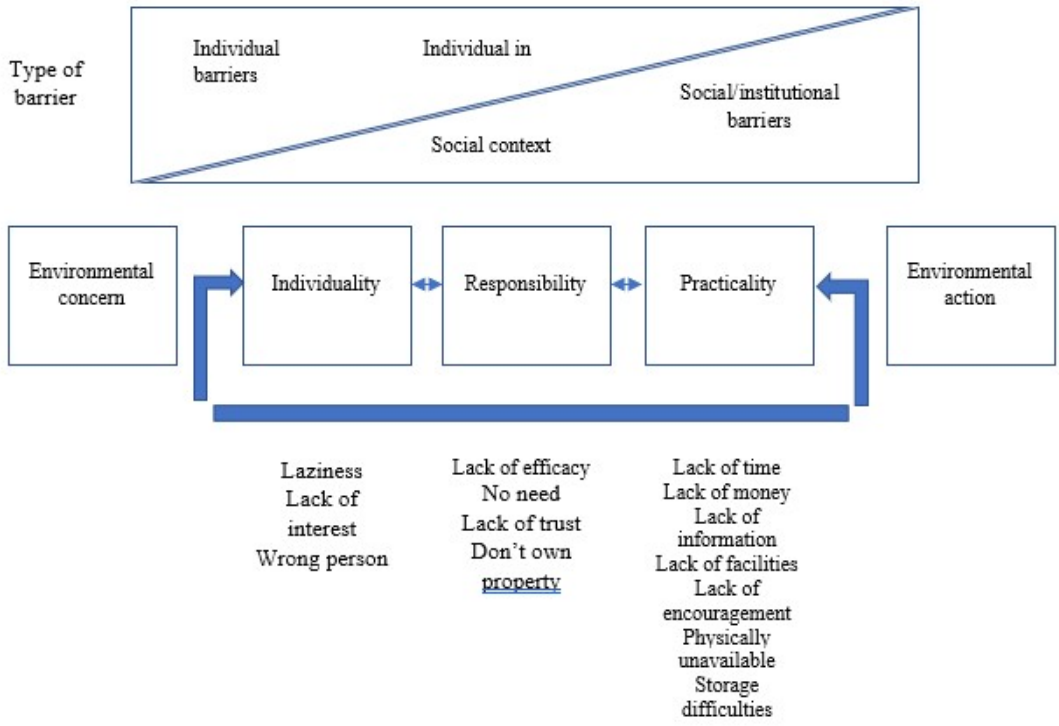

Figure 2.4: Author's adaptation of Blake's (1999) model of the 'Value-action gap'.

Studies that look at the Value-action gap specifically in relation to consumer behaviour and household food waste are still not plentiful and the question of whether household food waste is a societal or an individual responsibility continues to present tension within the literature. However, the view that pressures and routines of modern life create barriers to sustainable household practices is increasingly gaining traction and consensus.

Evans's (2011) clear voice and empirical studies champion the idea that food waste is a consequence of how modern lives are socially organised, and that since modern life is a product of our society, food waste should therefore be viewed as a shared responsibility rather than being squarely placed at the door of the individual consumer (Evans, 2011, 2014). Skinner et al. (2012) echo this sentiment. Through a social systems approach they spell out how the different domains of 'suburban ecosystems' (paid work, family and community) of modern life creates demands and resources for each individual and thus affect people's capacity to live sustainably (Skinner et al., 2012). Studies such as those of Evans (2014) and Skinner et al. (2012) highlight the need for attention to the role that both the social and the built environments play in relation to how households deal with food and food waste.

2.6.2 Lack of education

Research indicates that a lack of understanding of the negative consequences of throwing away food may be a significant barrier to food waste minimisation behaviour (Graham-Rowe et al., 2014; Quested et al., 2013). The variables concerning attitudes and commitment towards food waste are strongly associated with food waste behaviour (Secondi et al., 2015). Graham-Rowe et al (2014) found in their study that many respondents did not regard food waste as a real problem. Others saw it as an inevitable and normal practice that did not have much consequence. This may seem like a contradiction to results mentioned earlier, indicating that most people agree that throwing out food is wrong. Conversely, it may also be evidence that lack of education is a barrier between an awareness (however vague) that food waste is an issue, and pro-environmental action. Principato et al. (2015) found that 60% of respondents were more concerned about the effects of throwing out the packaging than wasting the food it came in (Principato et al., 2015). A general lack of awareness of the *amounts* of food that individual households themselves waste has also been widely documented (Graham-Rowe et al., 2014) – it is quite likely that this could be a consequence of the 'invisibility' of food waste which is 'being thrown away a bit at a time, often mixed with other household waste, stored outside the home, and regularly taken away and dumped out of sight' (Crocker, 2012; Graham-Rowe et al., 2014, p. 21).

There is some disagreement as to whether an awareness of the environmental impact of food waste is a motivator for food waste prevention. Many papers have shown that environmental concern does not necessarily translate into pro-environmental behaviour, which brings us back to the Value-action gap (Tucker & Farrelly, 2016b). This may be related to socio-demographic factors such as the level of education (Neff et al., 2015; Qi & Roe, 2016).

2.6.3 Psychological factors

Perceived behavioural control has been identified as an important direct predictor of intention to reduce food waste. Schanes et al. (2018) explain that '[c]onsumers who trust in their ability to reduce their waste and consider reducing food waste under their control, are more likely to reduce food waste directly or at least have a higher intention to do so' (Schanes et al., 2018, p. 982). 'Thus, although consumers may be very willing to reduce food waste at home, they waste less food if they feel they are in control over reducing food waste' (Visschers et al., 2016, p. 73). Visschers et al. (2016) confirm findings of many other studies on this topic, closely relating perceived behaviour control to the locus of control.

Research shows that food waste behaviour can be determined by both non-cognitive determinants (such as emotions and habits) and cognitive determinants (such as knowledge and perceived behaviour control) (Principato, 2018). Cognitive determinants have been shown by WRAP research to cause some people to disengage with the food waste issue if they are under the perception that 'no one else is acting on this issue' (Quested et al., 2013, p. 49), linking it to a diminished locus of control. So, while the value-action gap continues to baffle researchers, we see that individuals who feel in control of the performance of their actions and commit to make an effort to reduce their household food waste, actually manage to waste less food (Secondi et al., 2015).

Providing strong case examples and profiling the issue widely can be considered fundamental to normalising food waste behaviour. Elements incorporated into the built environment (such as communal composting hubs or spaces allocated for community gardens) could provide an important role in this regard, by providing visible signals that

food and food waste are integral components of modern life no matter how urban or busy (Burke & Napawan, 2020).

2.6.4 Temporal factors

Studies by Qi & Roe (2016) and Jörissen et al. (2015) indicate a clear correlation between constraints on people's time and food waste. The less time people have, the less time they have to worry about food waste, and hence it becomes deprioritised (Jörissen et al., 2015; Qi & Roe, 2016; Schanes et al., 2018). The issue of food waste must often compete for prioritisation against a long list of other issues that households are affronted with and often draws the shortest straw when weighed up in the big scheme of things (Graham-Rowe et al., 2014). As observed by Skinner et al (2014), 'the influence of twenty-first century patterns of work extends beyond the individual worker: they also affect children, family, friends, neighbours and the larger community' (p. 36).

2.6.5 Infrastructure and accessibility

Historically, urban settlements have had close food supply networks with their surrounding peri-urban and rural regions. Today, cities in developed countries are often supplied by supermarket-dominated food systems that have to a large degree supplanted regional food bonds and even domestic vegetable gardens, rendering them dependent on food sourced from more distant places (Hamm, 2015; Ministry for the Environment, 1997). Cities are increasingly becoming concerned about the risks that go with this dependency, 'recognising their responsibility in building more sustainable food systems that reduce food waste' (Dubbeling et al., 2016, p. 8).

Strategies, legislation and systems aimed at separating food waste from the waste stream vary widely on national, regional and even municipal levels across the world (BiPRO/CRI, 2015). Even very highly efficient European source-separation systems all have in common that they rely on households to carry out separation of household waste correctly to function properly (Bernstad, 2014). Numerous studies have been conducted on the relationship between household participation rates and factors such as demographics, age, socio-economic background, social norms, attitudes, and dwelling

types. As noted by Bernstad (2014), while results from such studies often vary, the factors of physical accessibility and convenience have nonetheless been shown to be 'important explanatory factors for waste recycling behaviour' (Bernstad, 2014, pp. 1317–1318). In this regard, access to a curb-side recycling scheme (as opposed to no recycling scheme or bring-systems) has been stated as a key influencing factor. However, the literature also shows a strong relationship between recycling behaviour and adequate indoor and outdoor temporary storage of materials awaiting collection (Bernstad, 2014).

Studies that consider the effect of the built environment and the factor of convenience with a specific focus on food waste are not plentiful (Närvänen et al., 2020a). Bernstad's (2014) study, however, supports previous findings on the importance of accessibility, convenience and physical infrastructure for households to participate in waste recycling (p.1322), while adding the importance of sufficient indoor storage space as well as 'normalization' of separation behaviour through habit formation and social norms.

As mentioned above, municipal waste disposal is often the only available option for urban households to manage their food waste, which places a great deal of importance on available local infrastructure for food waste management. It is widely agreed that composting is an ideal way to process food waste and composting is often the 'sole focus of existing food waste diversion programs' (Ai & Zheng, 2019, p. 38) in many of the world's cities. However, municipal composting at industrial scales in remote locations have been associated with other sets of issues, such as high transport costs and emissions and operational complexity (Bruni et al., 2020). Furthermore, it is not likely to deal with the issue of its 'invisibility'. Decentralised composting, or community composting, refers to a 'community-scale network in a specific neighbourhood that diverts and composts biowaste in a controlled operative environment' (Bruni et al., 2020, p. 8). It is an alternative to remote municipal composting that is receiving much interest from civil society and policy makers in Europe and North America (Ai & Zheng, 2019; Bruni et al., 2020). Decentralised composting offers the advantages of decreased operation and transportation costs, local processing and resource sharing, less cross-contamination from other waste, and a higher quality end product. By being locally based and more visible to residential neighbourhoods, decentralised composting – as long as it is well managed - could play a pivotal role in a city's efforts to address its food waste.

2.6.6 Spatial factors (the built environment)

Another fact of life for many modern households is that their physical situation is dominated by an urban environment. Since 1950, the world's urban population has grown four-fold; today, 55% of us live in urban areas. That figure is forecast to increase for decades to come, albeit at a decreased rate (United Nations, Department of Economic and Social Affairs, Population Division, 2019). Urbanization is a complex socio-economic process that transforms rural areas into urban settlements while also redistributing the population and concentrates its density rates. The resultant built environment is shaped by different land uses 'connected together with physical infrastructures and associated transport networks' (Ghosh & Vale, 2009, p. 507). Public and private interests shape the urban landscape through investments in buildings and infrastructure as well as spatial and urban planning. In turn, the built environment has a substantial effect on residents' occupations, lifestyle, culture and behaviour, and even social structures (Gifford, 2014; United Nations, Department of Economic and Social Affairs, Population Division, 2019).

Planning-related studies have pointed out influences of urban density rates and types of urban form on household environmental behaviours. These types of studies most frequently concentrate on greenhouse gas-related sustainability factors in relation to water, energy and transport, but it is acknowledged that other indicators should also be explored for a more holistic understanding of the effect of the built environment on urban sustainability (Grosvenor, 2015). The effects of the built environment on household food waste minimisation behaviour have not yet been studied to much extent. However, waste generation is 'closely linked to population, urbanization and affluence' (Bogner et al., 2007, p. 588). Results from the 2013 Flash Eurobarometer survey indicate that urban dwellers tend to produce more waste than people living in rural areas (Secondi et al., 2015). Secondi et al. (2015) have also found that 'individuals' perception of living in an area with little or no litter in the street is positively related with the production of small percentages of food waste' (Secondi et al., 2015, p. 34). Such results indicate that, although household behaviour is related to individual circumstances, the physical environment of where people reside may also have an important influence on their food waste habits. A study that will examine how, and to what extent, the built environment

may play a part in households' food waste minimisation and management efforts, would therefore be a very valuable contribution to the literature.

2.7 Conclusion

At a time in human history when large parts of the population live in material wealth, the world on a whole still faces the stark reality of hunger, inequality, environmental degradation, and climate change. Despite the availability of cutting edge agricultural, logistics and communication technology, the world's food production is still not optimised, and one third of the food that is produced is lost or wasted along the way towards the supermarket, the end consumer's plate, or the rubbish tip.

It is more resource efficient to reduce that loss rather than to produce more food (of which another third would be destined for the landfill) (Tucker & Farrelly, 2016b). While it is important for municipalities to divert biological materials from the waste stream and to process that material in the most environmentally sustainable ways, it is equally, if not more, important for communities around the world to question why such immense waste is deemed acceptable and even enabled. The problem of food waste is extremely complex and cannot be explained through one theory or model alone. All aspects of modern life that contribute to the consumer food waste issue, and aspects that act as barriers to pro-environmental behaviour, need to be examined and addressed from a multi-disciplinary and holistic platform, with the aim of developing collaborative, multi-stakeholder, systemic-level initiatives.

This thesis will now direct focus on to the specific geographical area of the tertiary precinct to explore local barriers to, and opportunities for, sustainable household food waste practices. Due to the demographic makeup of this area, the study will include considerations of how young people interact with food waste. It will also consider the effects of the built environment in the precinct. Results will be carefully examined in relation to research literature and policies that relate to the current food waste landscape. Direction of the study will be guided by the principles of Blake's (1999) Value-action gap theoretical framework.

Chapter 3: Methodology

The aim of this research project was to identify existing barriers to sustainable household food waste practices in Dunedin's tertiary precinct. This chapter will outline the methods used by the researcher for the purpose of achieving that aim.

To gain a comprehensive understanding of the types of factors that prevent households in the tertiary precinct from minimising their food waste or refraining from placing food waste in their weekly rubbish bin or bag, both primary and secondary research was carried out during the months March to November 2020.

Qualitative data were collected through several semi-structured interviews. An online survey produced a mixture of qualitative and quantitative data. The researcher also sourced secondary data through a comprehensive review of relevant literature and policies.

This chapter will provide justification for the methods employed for data collection and analysis. It will also discuss the project's limitations and explain how ethical considerations were observed.

3.1 Philosophical underpinnings

It is important for a researcher to premise the design of their research project on a philosophical standpoint, as it helps to guide the focus and direction of the study. It also gives a deeper meaning to the research, and it informs the research design (Kitchin & Tate, 2013). The research design for this project was based on a mixture of realist, existentialist and behaviouralist theoretical concepts.

Realism is 'concerned with the investigation of the underlying mechanisms and structures of social relations, and with identifying the "building blocks" of reality' (Kitchin & Tate, 2013, p. 15), including the underlying mechanisms of policies and

practices. This research will employ both qualitative and quantitative methods, which are methods often used in research that is underpinned by a realist philosophical standpoint. However, with a nod to both behaviouralist and existentialist perspectives, the researcher acknowledged that people are not robots and that their actions are 'mediated through the cognitive processing of information' (Kitchin & Tate, 2013, p. 9), which includes spatial behaviour. The researcher also acknowledges that every person is an individual whose reality and values are shaped by their own unique physical, psychological, spiritual, and emotional experiences. These philosophical foundations guided the way that the researcher approached the research problem by acting as a reminder to reject idealisations of how things *should* be, and to rather seek out facts as they stand at face value. They also helped to form lines of enquiry into the importance that participants place on food waste, and also to form an expectation to find confusing or juxtaposing results. The research design of this project will reflect these philosophical frames of reference.

3.2 Research design

To understand the household food waste issue in the precinct, it was vital to understand the mechanisms and barriers that enabled them to exist. To this end, it was necessary to uncover the range of values that residents of the precinct held in relation to food waste, and their levels of awareness of food waste-related issues. It was also critical to map out to which extent the physical environment could be a contributing factor to how households in the precinct dealt with their food waste. Once these underlying factors were understood, the issue could then be viewed within the broader context of community values, community networks, city planning, waste management and urban design. Literature and policy review helped with this orientation and offered valuable context and insight into how, or whether, municipal and spatial planning can positively influence the desired behaviour change. However, with the abovementioned philosophical foundations in mind, the researcher was very clear from the outset that while investigating tertiary precinct residents' relationship to domestic food waste is important to form an understanding of underlying factors, solutionist expectations to be able to 'box them up' and 'sort them out' should be rejected (Cockerill et al., 2017).

The nature of the research questions called for qualitative, experiential data rather than metric data since they were aiming at eliciting empirical and experiential knowledge from research participants. Qualitative research often involves observation, interviewing and examination of objects to imbue the researcher with an understanding of human experiences. Qualitative data can consist of words, meanings, pictures and sounds and is usually unstructured in nature (Kitchin & Tate, 2013). They can allow human perceptions and experiences to be explained, and then be put in relation to conceptual frameworks. For this reason, it was decided to employ predominantly qualitative research methods. For this type of research, the researcher should remain objective, although they will inevitably to some degree draw on personal experiences when interpreting their observations (Kitchin & Tate, 2013). Some quantitative data was also required, which would allow responses to some basic qualifying questions be analysed quantitatively (Kitchin & Tate, 2013).

3.2.1 Primary methods

A mixed-method approach that gathers both qualitative and quantitative data is accepted as a practical approach to research in social science disciplines (McNeill & Chapman, 2005). It was decided that this method would suit the aim of this research well, as it would be useful in collecting data on the types of barriers to sustainable domestic food waste practices that residents in the precinct experience, what their preferences would be and possibly even the relationship they have with food waste in terms of values and levels of education on its environmental impact.

Research methods used for this project involved one online survey and 13 semi-structured key informant interviews. Eleven of the interviews were one-on-one interviews, the remaining two were group interviews. The interviews produced mainly qualitative data through open-ended questions. The online survey produced a mixture of qualitative and quantitative data.

3.2.1.1 Online survey

Surveys can take a multitude of forms and may yield both qualitative and quantitative data – they can serve as very useful and flexible tools to researchers. Both closed-ended and open-ended questions may be used to encourage participants to divulge information about their experiences with, or opinions of, a specific issue (Bickman & Rog, 2009).

It was important for the integrity of the research to obtain data on food-related experiences, attitudes, and awareness directly from residents in the precinct. Surveys and questionnaires are often-used tools to obtain that type of data. An online survey presented itself as an obvious choice to the researcher early in the process: not only would it be time-efficient, cost-effective and easy to use, but it would also allow respondents to self-select for participation, and also for them to participate regardless of semester start and finish dates. With the added complication of the COVID-19 pandemic that has engulfed the world in 2020, a contactless means of data collection such as an online survey would be deemed an even more obvious choice in comparison to other types of surveys, e.g., street intercept surveys.

The online survey aimed at obtaining data relating to four themes:

1. What are households currently doing to minimise food waste and refrain from putting food in with the weekly rubbish?
2. What kind of relationship do they have with food waste?
3. What is keeping them from doing better with food waste?
4. What would help them do better with food waste?

Survey questions (both close-and open-ended) were tailored to obtain both this information and limited qualifying demographic data (for the survey to be effective, it was important that participants were residents of the precinct). Appendix D contains a copy of the survey questionnaire.

In an attempt to gather diverse views and provide an opportunity for all members of the precinct community to have their say, the researcher made efforts to have the survey advertised widely in the area. The survey was open to the public without a password, so

participants were able to self-select to take part. It was advertised (with a link and QR code) on social media and printed posters on both tertiary institutions' campuses, and some UO lectures. Table 3.1 lists the physical and online spaces where it was advertised:

Table 3.1: List of venues where the survey was advertised.

Physical spaces	University of Otago Dunedin campus notice boards: faculty buildings, cafes, lecture theatres, student association venues, congregation areas, Radio One office, OUSA notice boards.
	Otago Polytechnic Dunedin campus notice board, faculty notice boards, congregation area the Hub.
	Various tertiary precinct cafes and food outlets.
	The Gardens New World supermarket.
Online spaces	Facebook pages of Students for Environmental Action (SEA), personal page of researcher, School of Geography, and Geography and Environmental Management Students (GEMS) group.
	Instagram page of University of Otago Sustainability Office.
	Emails containing survey advertisement in PowerPoint format distributed to lecturers with a request for them to display them in lectures.

Appendix E contains a copy of the advertisement.

3.2.1.2 Key informant interviews

Interviews allow the researcher access to opinions, ideas, and knowledge that participants hold. Put simply, an interview is a conversation between two parties; as a very familiar and apparently simple form of communication it opens up for questioning on the part of

the interviewer and for elaboration on the part of the interviewee (Davies et al., 2003). Furthermore, interviews that are held face-to-face or over an audio-video link (such as Zoom) also allow for the exchange of visual prompts such as smiles and nods that researchers can use to engage and stimulate their participants (Walliman, 2018). To help inform future planning decisions in the context of food waste in the precinct, it was vital for this research to elicit the opinions of professionals and community champions with experience and knowledge from food waste policy related perspectives. It was decided that face-to-face interviews would serve as a very suitable method to achieve this.

Key informants were selected based on their professional roles and experience in professions such as waste management and minimisation, urban design, community engagement, and food waste research. Both purposive sampling and snowball sampling were used to recruit key informants. A total of 13 key informant interviews were conducted. The range of the roles held by key informants is contained in Appendix F.

As the format of each interview was to be semi-structured, the researcher had compiled a set of broad topics for discussion, rather than a list of specific questions. By using topics as conversation starters rather than a list of narrowly defined questions, the interviewer could allow the conversation to take on a natural flow without being too restrictive. Each interviewee had different areas of expertise and focus, which in turn influenced the direction of the interview, another reason why flexibility was important.

With permission given by the interviewee, every interview was recorded. This allowed the researcher to genuinely engage with the interviewee while only taking brief notes rather than having to record the entire meeting on paper as the meeting took place. Once completed, all interview recordings were transcribed in detail. Transcriptions were then coded for data analysis purposes using Otter transcription software.

A focus group is a group discussion organised for the purpose of exploring specific issues and is a useful qualitative research method (Kitzinger, 1994). Focus groups provide a social setting that allows the researcher to gain insight into information or attitudes that may not be accessible through one-on-one interviews (Liamputtong, 2011). For this research project, the researcher believed that a focus group attended by residents of the precinct may reveal food waste-related barriers and norms that may not be captured

through the survey. The researcher attempted to recruit focus group participants through the online survey questionnaire. The last question in the questionnaire asked survey participants to indicate whether they would be willing to participate in a focus group for the purpose of discussing issues around food waste in the precinct. Participants who answer 'yes' to that question were asked to provide their name and email address so that they can be contacted directly. This invitation only resulted in three participants coming forth for a meeting. The meeting therefore took on the shape of a group interview rather than a focus group. The group interview was recorded. The recording was then transcribed for the purpose of analysis using Otter transcription software. A list of topics for discussion in the interviews is contained in Appendix G.

3.2.2 Secondary methods

It is important for any research project that it incorporates a review of prior research that has already been done on the subject at hand (Stake, 2014). Both academic literature and policy documents (grey literature) were reviewed for this project to help the researcher gain a broad understanding of the context within which the food waste issue lies.

3.2.2.1 Literature review

A literature review informs the researcher on current knowledge and broad discussions involving the research topic, enabling them to appropriately analyse the findings of their research within a contextual framework (Vogt et al., 2012).

By conducting a comprehensive literature review the researcher was able to gain insight into the issues involving consumer food waste at the household level. Information on the topic is more plentiful from an international perspective but there was sufficient New Zealand-specific examples available through the growing body of literature for the researcher to draw comparisons to how national examples fared pitched against global experiences. This background information was very useful in placing the research project into context with current trends and issues, and it gave more substance to the rationale for the study. Concepts and insights gained from the literature review were used to inform the survey design, interview questions and result analysis.

The researcher also reviewed a set of statutory and non-statutory documents that guide and manage waste management and minimisation in New Zealand and Dunedin. This review enabled the researcher to gain an in-depth understanding of how well food waste is considered in relevant policy documents in New Zealand.

The literature and policy reviews were vital to the researcher's contextual understanding of domestic food waste; it helped to form questions for primary data collection and to analyse and discuss the results that they produced.

3.3 ANALYSIS AND INTERPRETATION OF RESULTS

Coding is a classification exercise where raw data is scanned for emergent and recurring words and phrases which are assigned unique identifiers named 'codes'. These codes are then allocated labels for the purpose of thematic classification, which assists the researcher to organise, interpret and summarise the collected information at the early stages of the process (Walliman, 2018). This type of coding and analysis exercise assisted the researcher in structuring the arguments which are presented in the Results and Discussion chapters of this thesis.

3.3.1 Processing of online survey results

Once the survey had closed, the data had to be organised in to convenient and discernible units. Qualtrics automatically graphed data from multi-choice or 'yes and no' answers, which allowed the themes to be spotted efficiently. Coding of free-text answers had to be processed separately, which was done with the help of the Quirkos coding software, which clustered data from these answers into themes, which could then be interpreted and analysed.

3.3.2 Processing of key informant interview results

Once interview recordings had been transcribed with the help of the Otto transcription software, the researcher identified and categorized key themes that had emerged during these meetings. This systematic coding and labelling process was invaluable to the researcher for making the volume of the data more manageable, for sense of the data and

to extract themes from it, and for identifying relationships between themes. Such analysis was an important and necessary step to complete before the Results and Discussion chapters could be written. A list of key themes that emerged from the coding process is shown below.

Table 3.2: Key themes identified from interviews.

Key themes identified from interviews
Food waste minimisation issues
The physical environment in the precinct
Social/cultural/economic links
Transient population
Infrastructure
Need for education and support
Food waste management issues
Role/involvement of councils and institutions
Responsibility
The nature of food waste
Community composting/community gardening/decentralised composting

3.4 Limitations of this research

3.4.1 Low number of survey participants

The results of this thesis included survey responses from 40 precinct residents. It is recognised that this is only a small sample of the entire precinct population. It can be considered a sample of the precinct population but not a full representation.

3.4.2 Majority of interview and focus group participants had an interest in food waste

It is possible that the majority of survey and focus group participants were already interested in or concerned about food waste (or in environmental issues generally). It is possible that the scope of participants may not have covered the entire spectrum of opinions held on household food waste issues in Dunedin. The researcher acknowledges these limitations. Results should be viewed with the potential for some results being slightly skewed in mind.

3.5 Ethical consideration

Researchers are responsible for ensuring that human participants' privacy is protected, both during the course of the project and after its conclusion. Researchers must also ensure they treat human participants with respect, and that their rights are observed (Walliman, 2018).

At the University of Otago, approval from the Human Ethics Committee is required before any student-led research involving human participants may proceed. Human Ethics Committee approval was completed prior to the commencement of this research project. A copy of the Ethics application is contained in Appendix H. The researcher took all practicable steps to ensure that any potential for harm was avoided at any point of interaction with participants.

Interview participants were sent an information sheet via email at least 24 hours prior to any interview, together with reassurances that they were free to ask questions, raise concerns about the study, or stop at any time. The Information Sheet for Interview Participants stated the aim of the research, the nature of the questions, reassured that participation was voluntary and that participants could withdraw at any stage with no disadvantage to them whatsoever, and that they would remain anonymous. A copy of the Information Sheet for Interview Participants is contained in Appendix H. Prior to the interviews, consent forms were signed by all participants.

To preserve the anonymity of all participants, a generic description (e.g., Local Government Official #1) was assigned to each participant during the data analysis phase.

These generic descriptions could then be used in the Results and Methods sections when referring to a participant, without revealing that person's identity.

3.6 Māori consultation

It was recognised by the researcher and the researcher's supervisor that the process and results of this research may contribute towards positive Te Ao Tūroa outcomes. In line with University of Otago's Policy for Research Consultation with Māori, a Research Consultation with Māori form was completed and submitted to the Ngāi Tahu Research Consultation Committee for assessment of consultation requirements.

3.7 Conclusion

This chapter has described the research methods that were used for this research project during 2020 in Dunedin. Theoretical underpinnings were outlined, and justifications for the mixed-methods approach provided. The process by which the data gathered from the research was processed was then explained. Ethical considerations were also addressed, as was the recognition of the need for guidance on how the research may be helpful in advancing the aspirations of Ngāi Tahu. Results from the research that has been described here will be presented and discussed in Chapters 5 and 6 in this thesis.

Chapter 4: Dunedin Context and Related Policies

This chapter will outline some of the tertiary precinct's demographic and built environment characteristics to provide some geographical context to the research. Related planning policies and initiatives will then be surveyed to link the research to strategic directions that are applicable for domestic food waste issues in the precinct.

4.1 Dunedin's tertiary precinct

Dunedin is a small city on the South-East coast of New Zealand's South Island with an estimated resident population of 134,100 (Statistics New Zealand, 2020). The city is known for its natural beauty, historic architecture, and marine wildlife (Enterprise Dunedin, 2020b). The Education and Training industry contributes significantly to Dunedin's economy; it is the second largest employer in the city and generates over 9% of its GDP (Infometrics, 2019).

Dunedin's two largest tertiary institutions, UO and OP, are the dominant institutions in this sector, together accommodating around 24,000 students and 4,500 staff (Dunedin City Tertiary Precinct Development Plan, 2008). Both institutions are situated in the tertiary precinct. Most students choose to reside near their place of study, making the tertiary precinct the largest concentration of 18-25-year-olds in New Zealand (Dunedin City Tertiary Precinct Development Plan, 2008).

For the purposes of this thesis, the tertiary precinct is defined as the area of approximately 165 hectares surrounding the tertiary institutions and residential area, bordered by George Street, Duke Street, Brook Street, Harbour Terrace, Parry Street and Hanover Street. This is the definition for the area that is used in the precinct development plan (Dunedin City Tertiary Precinct Development Plan, 2008). Refer to Figure 4.1 and Appendix A for a map of the area. Tertiary and residential activity dominate the area although there is also some significant commercial activity. Central to the tertiary precinct are the UO and OP campuses, which are well maintained with high amenity levels. The river Leith runs

through it and the Dunedin Botanic Garden neighbours it to the North-East. The Botanic Garden holds the status of six star Garden of International Significance (Dunedin Botanic Garden, 2020) and is a much valued recreational place in the area. Despite the large green space it offers, however, both fencing and the river Leith clearly separate it from the tertiary precinct and both atmosphere and amenity values are distinctly different in the two areas despite their close proximity.

State Highway 1 runs directly through the Western portion of the area, carrying more than 30,000 vehicles per day ("Otago Daily Times," 2020). The highway is divided along two roads (Cumberland Street and Great King Street North) with traffic going in separate directions - often referred to as 'the one-way system'. The Alhambra Rugby club and sports field sit between these two roads, providing a large, green open space adjacent to the OU campus. Located along approximately 300m of road to the North of the sports field are a concentration of fast food outlets, colloquially referred to as 'Fatty lane' (Newzealandliving, 2018). The Dunedin Central Business District (CBD) borders to the South and South-East of the tertiary precinct.

The vast majority of residents in the area are tertiary students. Student housing mostly consists of (with the exception of residential colleges) historic villas, workers cottages and terrace housing, interjected by newer housing developments (Dunedin City Tertiary Precinct Development Plan, 2008). Although the area's heritage structures give the streetscape a certain unique character, amenity levels are generally low due to a mixture of low maintenance of private spaces and buildings, and high littering rates. The streetscape is also dominated by high concentrations of parked cars, both on the streets and on paved front yards of private properties, a noticeable feature that further adds to loss of amenity in the area (Dunedin City Tertiary Precinct Development Plan, 2008).

The large student population adds a welcome cultural vibrancy and diversity to Dunedin. However, a long-standing trend of vandalism, littering and wilful breaking of glass in the area is a concern to the council, tertiary institutions, student bodies and other civic organisations (Elder, 2014; Morris, 2020b). A high concentration of young people in a relatively small area and cheap alcohol has been blamed for anti-social behaviour and alcohol abuse in the area (RNZ, 2019). In recent years, UO has addressed undesirable student behaviour by implementing a 'code of conduct' (Dunedin City Tertiary Precinct

Development Plan, 2008; Discipline Statute, 2011) and phasing out previously popular student pubs through buying them up and converting them into study spaces (RNZ, 2019).

The DCC has also identified a need to increase traffic safety, accessibility, and amenity levels in the Tertiary precinct. In line with the 10-year plan, they have embarked on a streetscape improvement project in this area (Dunedin City Council, 2020b). Further details on this project are provided in Section 4.2.1.7 below.

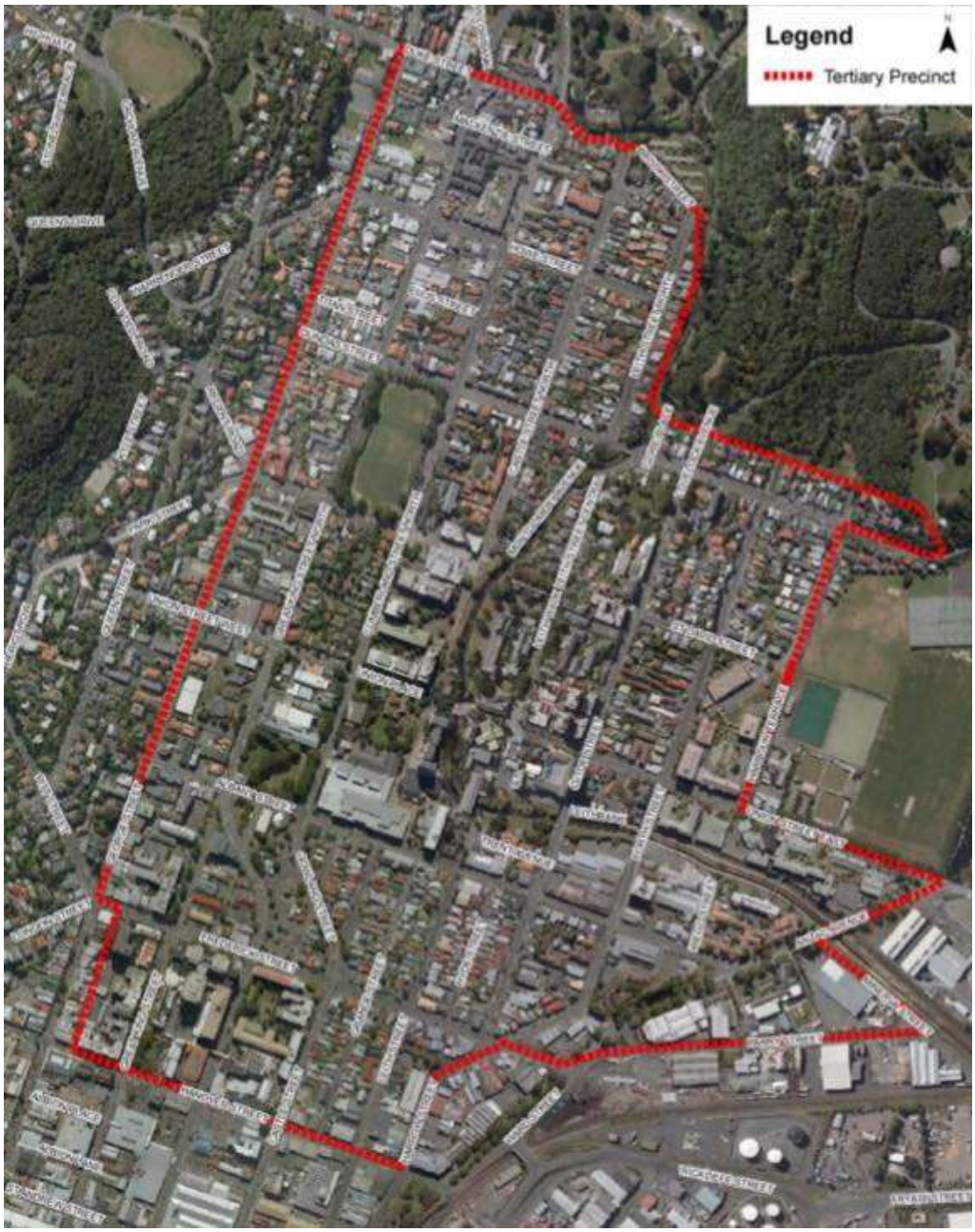

Figure 4.1: Map showing borders of the Tertiary Precinct.

4.2 Related policies and initiatives

As explained in the literature review, addressing food waste is gaining momentum internationally and has resulted in food-waste related policies and initiatives in many countries (von Massow et al., 2019). It is outside the scope of this thesis to analyse all plans and statutes that could relate to waste in New Zealand. This section will instead provide an overview of local policies and planning projects that are most relevant to domestic food waste in Dunedin's tertiary precinct. The intention here is to provide some examples for how food waste is, or could be, addressed through these overlapping initiatives. The section is organised by Government-led initiatives, Industry-led initiatives, and Community and institution-led initiatives.

4.2.1 Government-led initiatives

4.2.1.1 The New Zealand Waste Strategy 2010

The New Zealand Waste Strategy 2010 (NZWS) provides a high-level strategic direction for waste minimisation and management by setting out the Government's long-term priorities. The Strategy enables a flexible approach through two high-level goals:

- reducing the harmful effects of waste
- improving the efficiency of resource use

These two goals provide direction to local government, businesses (including the waste industry), and communities on where to focus their efforts in order to deliver environmental, social and economic benefits to all New Zealanders (Ministry for the Environment, 2010, p. 3). The NZWS plays an overarching role in a framework of legislation and guidelines for minimising and managing waste (see diagram in table 4.1 below).

Despite this framework, the NZWS does not target food waste specifically. In recognition of food waste's wide-ranging repercussions for the environment, the parliamentary

Environment Committee resolved in August 2018 to open a briefing to investigate food waste in New Zealand (Webb, 2020). Associate Professor Miranda Mirosa prepared a report for this briefing (The Mirosa Report), in which she points out:

> *New Zealand does not have a national food waste reduction target, nor a food waste reduction strategy, nor a prioritisation implementation plan identifying where investment in food waste reduction should be targeted. There is currently no national level coordination of a collaborative whole supply chain approach to food waste prevention, nor sufficient resourcing of waste reduction initiatives, nor a cooperative research approach* (Mirosa, 2019, p. 45).

The Mirosa Report produced 40 recommendations for the Environment Committee on ways forward to work on New Zealand's food waste issues. It also strongly encourages the adoption of a three-step road map approach for reducing food waste:

- Target – set a national food waste definition, strategy, and implementation plan.
- Measure – establish base year data and conduct a return on investment analysis.
- Act – address identified food waste issues through immediate action.

(Mirosa, 2019, p. 74)

Following their consideration of the briefing, the Environment Committee produced a report with the following three recommendations:

1. We recommend that the House and Government take note of the appended report about food waste in New Zealand, drafted by the committee's adviser, Associate Professor Miranda Mirosa.

2. We recommend that the Government adopt a national definition of and measure of food waste, in line with international approaches.

3. We recommend that the Government include reducing food waste with a reduction target as part of a national waste strategy and implementation plan.

(Webb, 2020, p. 2)

The interest afforded to food waste by the Environment Committee is promising. With more weight being put behind the movement by central government, we can expect a ripple effect to cause further appetite for this problem at local levels too.

Table 4.1: Framework for managing and minimising waste in New Zealand – based on table in NZWS 2010 p.4.

New Zealand Waste Strategy 2010					
Legislation and regulatory framework					
Waste Minimisation Act 2008	**Local Government Act 2002**	**Hazardous Substances and New Organisms Act 1996**	**Climate Change Response Act 2002**	**Resource Management Act 1991**	**Other Tools**
Waste minimisation and management plans	Bylaws	Regulations and group standards related to waste	Disposal facility regulations	Natural environmental standards	International conventions
Waste disposal levy	Long Term council plans			Regional Policy Statement, Regional plans, resource consents	Ministry guidelines, codes of practice, and voluntary initiatives
Waste minimisation fund	Annual council plans			District and regional plans resource consents	Iwi Management plans
Product stewardship					Litter Act 1979
Other regulations					

4.2.1.2 The RMA and LGA

There are two core pieces of legislation that outline the framework for resource management and sustainable development services which local governments in New Zealand must adhere to: The Resource Management Act 1991 (RMA) and the Local Government Act 2002 (LGA). The RMA and the LGA are key pieces of legislation that provide opportunities for addressing waste in general and food waste specifically.

Central to the purpose of both these high-level legislations is the multi-dimensional well-beings of current and future communities. The amount of importance afforded to food waste-related issues within this purpose is often a matter of interpretation by local authorities and planners, other legislation, and local resource management plans.

The RMA is an 'effects-based' legislation which focuses on managing the effects of activities rather than regulating the activities themselves' (Environment Foundation, 2018). Mismanaged food waste has the potential to cause wide-ranging, adverse effects to the environment through discharges to air, water and land. Section 15 of the RMA (Discharge of contaminants into environment) restricts any discharge of contaminants onto or into land, air, or water unless the discharge is expressly allowed by other regulations such as a national environmental standard, a rule in an operational or proposed regional plan, or a resource consent (Resource Management Act, 1991, sec. 15). We therefore need to look to lower-level plans for regulations that would affect food waste management locally. Under the RMA, regional councils regulate the environmental effects of waste disposal facilities through regional policy statements, regional plans, and resource consents.

4.2.1.3 The Waste Minimisation Act 2008

The Waste Minimisation Act 2008 (WMA) is the 'main legislation enabling the government's resource efficiency and waste portfolio' (Mirosa, 2019, p. 13). It aims to 'reduce the environmental harm of waste and provide economic, social and cultural benefits for New Zealand' (Ministry for the Environment, 2020b) by encouraging a reduction in waste generation and disposal. The WMA seeks to achieve its aims through

different mechanisms such as Product Stewardship requirements, the Waste Disposal Levy, and the Waste Minimisation Fund. The Waste Disposal Levy imposes a charge of $10.00 per tonne of waste sent to landfill. The levy (which may be increased in the near future) acts as a deterrent to sending waste to landfill, and 'provides for funding opportunities for waste minimisation initiatives (Mirosa, 2019, p. 13) through the Waste Minimisation Fund (WMF). Examples of local food waste projects supported by the WMF in the past include Love Food Hate Waste, Kiwi Harvest, and the Otago Polytechnic food waste composting project. The WMA also requires Territorial Authorities (TAs) to conduct Waste Assessments and to review their Waste Minimisation and Management Plans.

4.2.1.4 Regional policies

The Partially Operative Otago Regional Policy Statement 2019 (RPS 2019) recognises that sustainable management of waste materials will support the long-term resilience of communities. The RPS directs that information and guidance on waste minimisation and management should be provided by Regional, city and district councils in Otago (Otago Regional Policy Statement 2019, n.d., sec. 7.1.5). Regional waste plans are not always mandatory under the RMA. However, the Otago Waste Plan was developed by the ORC after careful considerations that such a plan was 'necessary to give effect to the purpose of the [RMA], and the most appropriate means of dealing with regional waste issues' (Otago Waste Plan, 1997, p. 3). Waste minimisation and management plans, on the other hand, are non-RMA statutory documents required to be developed by city and district councils. The Waste Minimisation and Management Plan for Dunedin will be outlined below (see Section 4.4). The Otago Waste Plan is due for renewal and a review has been commenced (Environmental Protection Authority, 2020).

The Otago Waste Plan does not refer to food waste specifically. However, it does contain rules for the activities of greenwaste landfills and composting. Discharge of contaminants or water into water, air or into or onto land as a result of these activities are permitted if certain conditions are met:

Rule 7.6.10 Greenwaste landfills (permitted activity)

1. The discharge of any contaminant into or onto land;
2. The discharge of any contaminant or water into water; or
3. The discharge of any contaminant to air,

when occurring as a result of any greenwaste landfill is a permitted activity, provided that:

a) Only greenwaste is disposed of at the greenwaste landfill;
b) Any excavation is dug in a manner so as to avoid groundwater seepage into the pit;
c) It is not dug within 100 metres, horizontally, of a well used to provide water for domestic purposes or drinking water for livestock;
d) Any leachate produced from the greenwaste landfill does not enter any water body;
e) The greenwaste landfill is not positioned within 50 metres, horizontally, of any river, lake, stream, pond, wetland or mean high water springs;
f) The greenwaste landfill does not cause a nuisance and is not noxious, dangerous, offensive, or objectionable beyond the boundaries of the property.

Rule 7.6.12 Composting (permitted activity)

1. The discharge of any contaminant into or onto land;
2. The discharge of any contaminant or water into water; or
3. The discharge of any contaminant to air,

when occurring as the result of composting of organic material is a permitted activity provided that:

1) Any excavation is dug in a manner so as to avoid groundwater seepage into the pit;
2) The activity is not undertaken within 100 metres, horizontally, of a well used to provide water for domestic purposes or drinking water for livestock;
3) Any leachate produced from compost does not enter any water body;
4) The composting is not undertaken within 50 metres horizontally, of any river, lake, stream, pond, wetland or mean high water springs;

5) The composting is undertaken on the property from which the majority of the material is sourced; (f) The composting does not cause a nuisance and is not noxious, dangerous, offensive, or objectionable beyond the boundaries of the property.

(Otago Waste Plan, 1997, sec. 7.6.10, 7.6.12)

Greenwaste and composting activities that cannot meet the above conditions become discretionary activities and trigger the requirement for a resource consent (Otago Waste Plan, 1997, sec. 7.6.11, 7.6.13). The Otago Waste Plan does not distinguish food waste from greenfill sites. It is therefore understood that greenfill sites that accept/process food waste as well as other greenwaste would be bound by rule 7.6.9.1. The Otago Waste Plan permits the activity of composting if conditions in rules 7.6.12(a-d, f) are met, most of which appear to be meant for the prevention of excessive discharges to air or contamination of water bodies or groundwater. Rule 7.6.12(e), however, contains the additional condition which stipulates that the composting must be 'undertaken on the property from which the majority of the material is sourced'. This rule may be perceived as a barrier to community groups, such as community gardens, who wish to offer community composting facilities to local residents. Further discussion on this point can be found in Section 6.4.2.4 of this thesis.

4.2.1.5 Dunedin's Waste Minimisation and Management Plan

New Zealand TAs play a key waste minimisation and management role at the local level. The DCC has a dedicated waste minimisation team, consisting of three staff. This team covers a lot of ground and delivers a well-rounded approach to waste minimisation for the city, which includes considerations of food waste. For example, they support and collaborate with community groups such as the Love Food Hate Waste campaign and Kiwi Harvest food rescue organisation, they facilitate outreach and education such as local workshops on composting, and they administer Waste Minimisation Grants for community initiatives. Planning duties include conducting Waste Assessments and development of the Waste Minimisation and Management Plan for the city – the most recent one being the Waste Minimisation and Management Plan 2020 (WMMP 2020).

There is currently no municipal kerbside collection service for separated domestic food waste or other organic waste in Dunedin. In recent years, there has been an increased public demand for DCC's kerbside collection service to incorporate organic waste. The DCC recognised this demand and commissioned a report on the issue in 2018 (Tonkin & Taylor Ltd, 2018). As part of this process, the DCC has identified organics (food and/or green waste) as a potential component of the Dunedin waste stream to incorporate into their kerbside collection system. Around the same time, the Waste Assessment 2018 also identified the following waste service issues specific to the tertiary precinct:

- There is not enough glass and mixed recycling bin capacity to accommodate a student flat.
- Students are confused by the fortnightly rotation of recycling services.
- There are high levels of contamination in Mixed Recycling Bins.

(Dunedin City Council, 2018)

The WMMP 2020 confirms Dunedin's commitment to advance towards zero waste, inclusive of a circular economy, by 2030. Informed by the Waste Assessment 2018, which identified a demand for organic waste recovery, the WMMP2020 lays out strategic directions through goals and targets, and implementation pathways through objectives, policies and methods.

The WMMP 2020 targets are:

1. Reduce the municipal solid waste generation per capita by at least 15% by 2030 compared to 2015.
2. Reduce the amount of municipal solid waste disposed to landfill and incineration by at least 50% by 2030 compared to 2015.
3. Increase the diversion rate away from landfill and incineration to at least 70% by 2030.

Under Objective 2 ('The community has access to diverted materials services'), the WMMP 2020 includes provisions to 'Investigate a collection service for organic waste –

food scraps and/or green waste' (Waste Minimisation and Management Plan, 2020), and for a new kerbside collection service to be established within 3-4 years.

Currently, the kerbside waste and recycling collection service offered by the DCC includes:

- Weekly collection of a pre-paid black rubbish bag
- Fortnightly glass recycling collection (blue crate)
- Fortnightly mixed recycling collection, alternate week (yellow-lidded bin)

During March and April 2020, the DCC engaged with Kāi Tahu and the wider community on two proposed options for an improved service. The engagement was done via the DCC Waste Futures programme. The aim of the Waste Futures programme is to, based on a circular economy approach, improve Dunedin's whole waste system. Results from that engagement has not yet been made public. Full consultation on the preferred proposed kerbside collection service is expected to be done as part of the 10 Year Plan process for the period 2021–2031 (Dunedin City Council, 2020c).

The two options presented were:

Option 1 - Three Bins

- DCC pre-paid black rubbish bags are replaced with a red-lidded rubbish bin (to be collected weekly).
- Existing service for glass collection to remain (to be collected fortnightly).
- Existing service for mixed recycling collection to remain (to be collected fortnightly).

Figure 4.2: Bins for Option 1 of a proposed new kerbside service. Source: Dunedin City Council, 2020b.

Option 2 - Four Bins

- DCC pre-paid black rubbish bags are replaced with a red-lidded rubbish bin (to be collected fortnightly).
- A green-lidded bin for food and garden waste is added (to be collected weekly).
- Existing service for glass collection to remain (to be collected fortnightly).
- Existing service for mixed recycling collection to remain (to be collected fortnightly).

Figure 4.3: Bins for Option 2 of a proposed new kerbside service. Source: Dunedin City Council, 2020b.

With Option 1, food waste would remain mixed with other general waste, placed in the red bin, and would go to landfill.

With Option 2, households would separate food waste and other organic waste from the general waste and place it in the green bin. For this option to be realised, the council would either need to invest in infrastructure to process the organic waste or engage a third-party contractor to do the same.

The WMMP 2020 also addresses food waste minimisation through collaboration, education, and empowerment so that 'Dunedin communities and learning agencies are actively engaged in zero waste education and are empowered to act with local initiative' (Objective 8) and 'Dunedin businesses minimise waste, are resource efficient and demonstrate innovation which grows or attracts sustainable market opportunities to the city' (Objective 9).

4.2.1.6 Tertiary Precinct Development Plan 2008

The Tertiary Development Plan resulted as a collaboration between DCC, the University of Otago and Otago Polytechnic, formalising a unique 'town and gown' relationship. The

overall mission for the Tertiary Development Plan is 'to contribute to the creation of a quality, sustainable campus environment and a vibrant tertiary precinct, ensuring Dunedin's place as the Education Capital of New Zealand' (s.6). The plan outlines key issues facing the tertiary precinct and a shared vision for the area including objectives and actions for the future, while providing direction for development in the campus area. The objectives for developing the Development Plan include:

- To ensure a co-ordinated approach to planning for the future of the tertiary sector and joint campus area,
- To identify future infrastructure needs of the tertiary sector and campus area, and
- To add value to the student experience in Dunedin and enhance Dunedin as an education destination.

The plan identifies five issue areas, each with their own lists of issues, objectives and proposed actions.

For the purposes of this thesis, the issue areas of Student housing (s 8.3); Campus environment, Facilities, amenities and open space (s 8.4); and Infrastructure/Information Technology (s 8.5) are noteworthy, as these components have the potential to interface with approaches to minimising and managing food waste.

Student housing (s 8.3)

While there were no specific mentions of waste and food waste in relation to housing in this section, there are general things that apply. Parked cars, on-site car parking requirements and *ad hoc* infill and redevelopment were identified as contributing to low amenity in the area. Also, a high concentration of students in the area may contribute to segregation of students from the wider community. At first glance, these student housing issues may seem unrelated to how the local population interacts with domestic food waste. However, as this thesis involves a regard of the built environment's influence on sustainable household food waste practices, it is valuable background information.

Actions listed to address identified housing issues included for the council to conduct a review of applicable rules in the Dunedin District Plan. Changes related to this point is

discussed further in Chapter 6 – Barriers to Sustainable Domestic Food Waste management. The plan also directed the tertiary institutions in the area to 'encourage and promote sustainable practices within the student housing area' (p.18). Both institutions are actively working on this action: see below for information on UO's planned 'Sustainability Neighbourhood' and OP's composting facility and Living Campus.

Campus Environment, Facilities, Amenities and Open Space (s 8.4)

Related to the student housing and amenity issues shown above, the Tertiary Development Plan lists the following issues listed for the campus environment:

- On-going issues with rubbish collection, broken bottles and vandalism resulting in low quality streetscapes.

- Lack of communal open space for recreation has a negative impact on student behaviour (e.g., there are noticeably more broken bottles in areas where there are no playing fields).

- Private open spaces have in many cases been paved over for parking to meet requirements in the District Plan. This results in the loss of residential amenity space.

The plan proposes a list of actions to address the above issues. The below selected actions highlight potential opportunities to address food waste while at the same time meet the objectives laid out in the plan:

- Continue to review and rationalise rubbish collection contracts to address the particular needs of North Dunedin (consider increasing frequency of collection, and greater flexibility towards students).
- Develop further 'clean-up' initiatives within the campus area
- Develop 'clean-up' initiatives to improve cleanliness and appearance of the wider city.

- Establish on-going education programmes regarding rubbish and recycling and consider providing alternatives such as bottle banks and cash incentives for bottle recycling.
- Develop new micro-parks/village greens where possible.
- Create communal, covered eating areas throughout the campus, including free outdoor BBQ facilities.
- The development of a new campus signage system that is consistent throughout the area and provides linkage between the tertiary organisations.

Discussions on how the above issues relate to domestic food waste in the tertiary precinct can be found in Chapters 5 and 6 of this thesis.

4.2.1.7 Tertiary precinct safety and amenity upgrade

The DCC has partnered with the University of Otago, Otago Polytechnic, Waka Kotahi NZ Transport Agency, Otago Regional Council and Aukaha on a project to improve the safety, accessibility, amenity, and atmosphere of selected streets in the tertiary precinct. A map of the streets that are selected for the Tertiary Precinct Project is shown in Figure 4.4 below and Appendix I. The project is still in an early phase, but work has commenced on public consultation, developing a business case and preliminary designs (Dunedin City Council, 2020b). The project is in line with actions and priorities identified in the Tertiary Development Plan. The overarching objectives for this project are as follows:

a) Establish the Tertiary Precinct as a destination (not a through route).

b) Establish future focussed, multi-purpose streets and an environment that enhances lifestyle as well as safety.

c) Improve the pedestrian and cycling experience in and around the tertiary campuses.

d) Establish improved network connections between tertiary campuses, Central City, harbour and Waters of Leith.

e) Address existing and/or potential future safety issues.

f) Maintain and improve wider transport network connections and functionality.

(Dunedin City Council, 2020b)

This planned street upgrade introduces opportunities for project partners to utilise the built environment for spotlighting the important role that food plays within the urban metabolism. By facilitating an environment that enables – or even encourages – users of the streetscape to engage in sustainable food-related activities (such as food sharing or urban micro gardening), the tertiary street upgrade could have a positive influence on how people in the area interact with food, and therefore also the waste of food. This project also has excellent potential for incorporating elements of other DCC initiatives, such as recycling hubs and suggested future organic waste collection (Option 2) outlined in Section 4.2.1.5 above.

Figure 4.4: Map of selected streets for the tertiary precinct project

4.2.2 Industry-led initiatives

4.2.2.1 WasteMINZ and Love Food Hate Waste

The Waste Management Institute New Zealand (WasteMINZ) is 'the largest representative body of the waste, resource recovery and contaminated land sectors in New Zealand' (WasteMINZ, 2020a). WasteMINZ collaborate with government agencies and industry partners on waste issues in New Zealand, including providing feedback and workshops and seminars on topical issues that arise in the waste landscape. In recent years, WasteMINZ has assumed a leadership role in food waste research. For example, in a collaboration with the University of Otago, WasteMINZ embarked on the National Food Waste Prevention Project in 2013, which aimed at quantifying food waste in New Zealand by analysing stages of the supply chain (WasteMINZ, 2020b).

In 2016, WasteMINZ partnered with the Ministry for the Environment and 60 councils and community groups around the country to launch the Love Food Hate Waste (LFHW) campaign. LFHW originated in Great Britain where it has been very successful in influencing food waste behaviours (Love Food Hate Waste New Zealand, 2020).

4.2.3 Community and institution-led initiatives

4.2.3.1 The planned sustainability neighbourhoods

Starting in 2021, UO's Sustainability Office and University Flats will pilot a new type of flatting experience. The planned Sustainability Neighbourhood will assist a small group of OU students to live their sustainability values while at the same time be involved in related research. The selected flats will be set up for the students to lead active and healthy lives, grow food, compost, and be energy efficient. University staff expect to gain valuable insights through this initiative – learning that will likely have an impact 'on the flatting scene as a whole', and that will be featured in presentations and publications (Goodger, 2020; Otago Bulletin Board, 2020). The Sustainability Neighbourhood

initiative aligns with the UO Sustainability strategic framework 2017-2021. This exciting initiative could have the potential to affect change in the tertiary precinct culture from the inside out through normalisation of sustainable lifestyles, and through that change also address domestic food waste.

4.2.3.2 The University of Otago Sustainability Strategic Framework

This framework reflects UO's commitment to embed sustainability into the organisation's operations and ethos. It lays out six interconnected themes within which strategies and activities are laid out:

1. Apply a whole systems approach.
2. Lead by example through operations.
3. Nurture a culture of sustainability.
4. Enhance sustainability research.
5. Support education for sustainability.
6. Collaborate and be a catalyst for change.

The Sustainability Neighbourhood initiative mentioned above aligns with themes 3 (Nurture a culture of sustainability) and 4 (Enhance sustainability research) in particular. The planned Sustainability Neighbourhoods have the potential to fulfil the role of a 'Living Laboratory' through which operations, research, teaching and learning can interconnect in a reciprocal system of feed-back and advancement, working together towards the development of an institution-wide culture of sustainability (University of Otago, 2017). There is great potential for enhanced awareness, understanding and values around food and food waste to be nurtured within such a culture.

4.2.3.3 Otago Polytechnic's sustainability vision and composting facility

With sustainability as one of their core values, OP's pledge is to 'do the right thing' (Scott et al., n.d.). OP's vision includes:

- Developing a framework to ensure they meet their sustainability objectives,
- Exploring the challenges, and asking the hard questions,
- Turning vision into practice by 'walking the talk',
- Focusing on student engagement by weaving sustainable practice into all their programmes, and
- Making long-term sustainability goals to work towards.

The OP sustainability values can be seen reflected in their Living Campus. First of its kind in Australasia, the Living Campus utilises green spaces on the OP campus to model examples of permaculture principles through food growing, biodiversity, sustainable building materials, energy efficiency, waste and water recycling, and using plant material for cultural, artistic and therapeutic purposes (Otago Polytechnic, 2020b). OP students are encouraged to engage in gardening, to pick free fresh greens to subsidise their grocery bills, learn about composting and worm farming, and even book a pizza oven or hangi pit for their own social events.

OP has also recently improved their on-site composting capacity. A new food waste processing facility has been developed to include food waste generated on campus, including food waste from their residential college and hospitality teaching arm, and even private households that wish to take part. The facility will also be valuable as an educational platform (Boyle et al., 2018; Otago Polytechnic, 2019, 2020a).

4.2.3.4 Social organisations

There are a number of community-based food rescue organisations throughout the country that are dedicated to redistribute food that would otherwise go to waste, on to private individuals or other organisations that want and need it (Mirosa, 2019). KiwiHarvest is one such organisation – this organisation originated in Dunedin with the help of the Waste Minimisation Fund and has now expanded to four additional New Zealand centres. Food rescue organisations distribute hundreds of tonnes of food back

into the community each year (*KiwiHarvest*, 2019). Rescuing and redistributing food, growing food locally and recycling food locally (e.g., through through worm farming) are activities that either avoid food being wasted entirely or that divert food waste from the landfill.

Other community-based initiatives include:

- Social supermarkets: Sells or gives away surplus food that has been donated or sold at low cost from food retailers or other suppliers (Mirosa, 2019). There does not appear to be any social supermarkets currently operating in Dunedin.

- Social cafes/restaurants: Like social supermarkets, these provide free or pay-as-you-feel sit-down meals made from rescued food (Mirosa, 2019). There does not appear to be any social supermarkets currently operating in Dunedin.

- Community pantries and fridges: These are either places within community centres or particular points in public spaces where community members or local businesses can drop off excess food for anyone to help themselves to. The convenience of these drop-off points is proving very popular and community pantries especially are growing in numbers; there are currently at least eleven community pantries to be found around Dunedin (Enterprise Dunedin, 2020a). One example is the community pantry in Tonga Park, South Dunedin, that was created in July 2019 through a collaboration between community members, a local Nations church, the Otago Corrections Facility, and the DCC (Wilson, 2019).

- Food sharing apps: These are digital tools for community members to share food among households and businesses to give away or sell heavily discounted food to the community and charitable organisations. Two examples of food sharing apps currently available in Dunedin are Foodprint (Foodprint, 2019) and Olio (OLIO, 2020).

- Community gardens: These are plots of land that are tended by collaborative groups of people for growing food and ornamentals. There are more than 20 community gardens in and around Dunedin. The organisation Students for Environmental Action (SEA) runs a student-led and initiated community garden within the tertiary precinct, close to both the OU and OP campuses. In June 2020, the garden was moved from the corner of Albany Street and Anzac Avenue to a new location on the corner of Dundas Street and Forth Street through collaboration with UO, Otago University Students' Association (OUSA), Studholme College and UniCrew Volunteers. SAE runs weekly garden working bees that are open to students and the wider community to grow and harvest edible plants (SEA Ōtepoti, 2020).

Community gardening and food sharing do not only have environmental value due to the food they divert from the landfill, but obvious social and economic value as well (Mirosa, 2019).

4.3 Conclusion

This chapter has shown that there are currently many food waste-related initiatives in motion in New Zealand, both on the policy and planning front and on the community front. While there is still much ground left to be covered before New Zealand catches up with other leading countries in the world, this development is encouraging; it has the potential to accelerate quickly and grow into a formidable movement for positive change. This chapter also provided background information on the geographical characteristics of the tertiary precinct. From these descriptions, a picture emerged of an environment of contrasts. The built environment is highly urban in character; indeed, it offers residents a central location conveniently close to the city centre. The main engines of activity in the precinct are the campuses of the two large tertiary institutions, which are what attract residents to the area in the first place. The campuses are comfortable with an affluent, park-like feel in places – which can also be found in the botanic garden on the outskirts of the precinct. Directly outside of these zones of calm and order, however, we find streetscapes cramped and clogged with traffic, parked cars, litter and broken glass intersecting neighbourhoods of often poorly maintained historic residences. To what

extent this type of environment plays a part in residents' ability or inclination to minimise or manage their domestic food waste will be explored in chapters 5 and 6 of this thesis.

Chapter 5: Barriers to Domestic Food Waste Minimisation in the Tertiary Precinct

As seen in the previous chapters, there are many reasons to explore existing barriers to sustainable domestic food waste practices in the tertiary precinct at this time. Several different initiatives are in motion, spurred by local governments, tertiary institutions, and community alike, that may have direct or indirect impacts on domestic food waste in the precinct.

This chapter examines these barriers, as they emerged during the research. Specifically, this chapter addresses **Research Question 1,** which is:

1A: What are the barriers to sustainable food waste minimisation practices among households in Dunedin's tertiary precinct?

and

1B: How does the built environment influence residents of the tertiary precinct's ability to minimise their domestic food waste?

The findings are grouped into three main themes that emerged from the research:

1. Food waste minimisation education, focus, engagement and skills,
2. Lifestyles of local residents, and
3. Influences of the built environment.

For themes 1 and 3, results from both interviews and surveys are presented before being discussed. No survey results were assigned to theme 2, so for that theme interview results will be presented, then discussed.

Firstly, some basic information will be provided to describe the survey sample. The chapter will then present results and discussion on the levels of domestic skills, education and awareness about food waste issues in the precinct. It will then go on to examine how individual lifestyles may impact on food waste minimisation. Lastly, influences of the built environment on local residents' food waste minimisation abilities will be considered.

5.1 Demographic and situational information

The first question of the survey was designed to inform participants on the purpose of the research, ensure that participants were over 18 years of age, reassure people of their anonymity, and capture their Consent to Participate. Participants who answered 'yes' to Question 1 were able to continue through to complete the rest of the survey. Anyone who answered 'no' to Question 1 would be redirected to the survey's last page, (thanking them for their participation) and not given access to the survey. All participants, 43 in total, answered 'yes' to Question 1.

Questions 2-5 sought some demographic and situational information to gain an understanding of the representativeness of the respondents and potentially identifying limitations of the sample. Question 2 sought to confirm that survey respondents were residents of the geographical area that the study focuses on. Three respondents answered 'no' to this question. Responses from those participants were not considered in the analysis of survey data, bringing the data set for processing down to 40.

Question 3 asked participants to indicate their main occupation. As shown in Figure 5.1, thirty-eight participants were students, one was professional, and one chose not to declare an occupation.

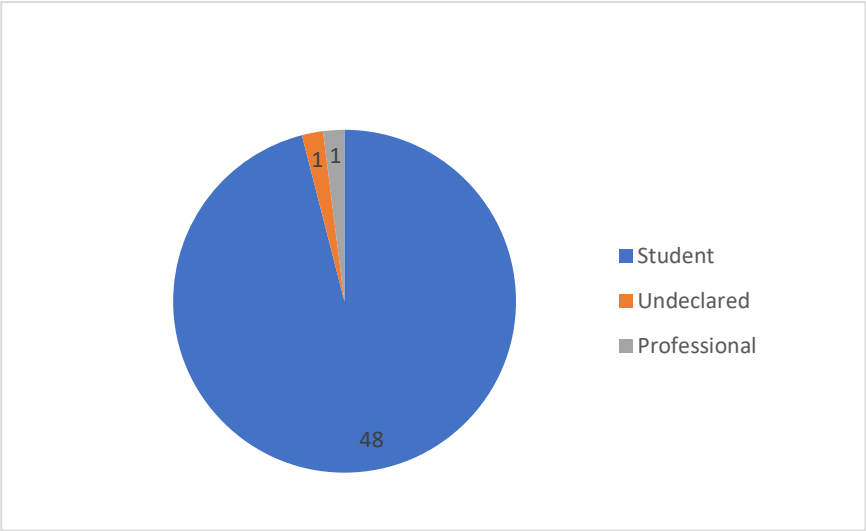

Figure 5.1: Occupations of survey participants

During the design of the survey, the researcher had realised that there was a potential for results to be skewed if all responses were from people who were engaged in studies with an environmental focus, e.g., Environmental Management. Question 4 was designed to reveal which subjects that respondents were currently enrolled in, thereby identifying potential limitations in representativeness of the sample. Figure 5.2 shows how Planning, Geography and Environmental Management are heavily represented subjects. However, there is also relatively even representation from Science, Arts, and Commerce subjects. Students enrolled in Midwifery and Occupational Therapy subjects also took part; those subjects are taught at Otago Polytechnic, showing that the sample contains respondents from both tertiary institutions of the precinct. Some respondents were enrolled in more than one subject.

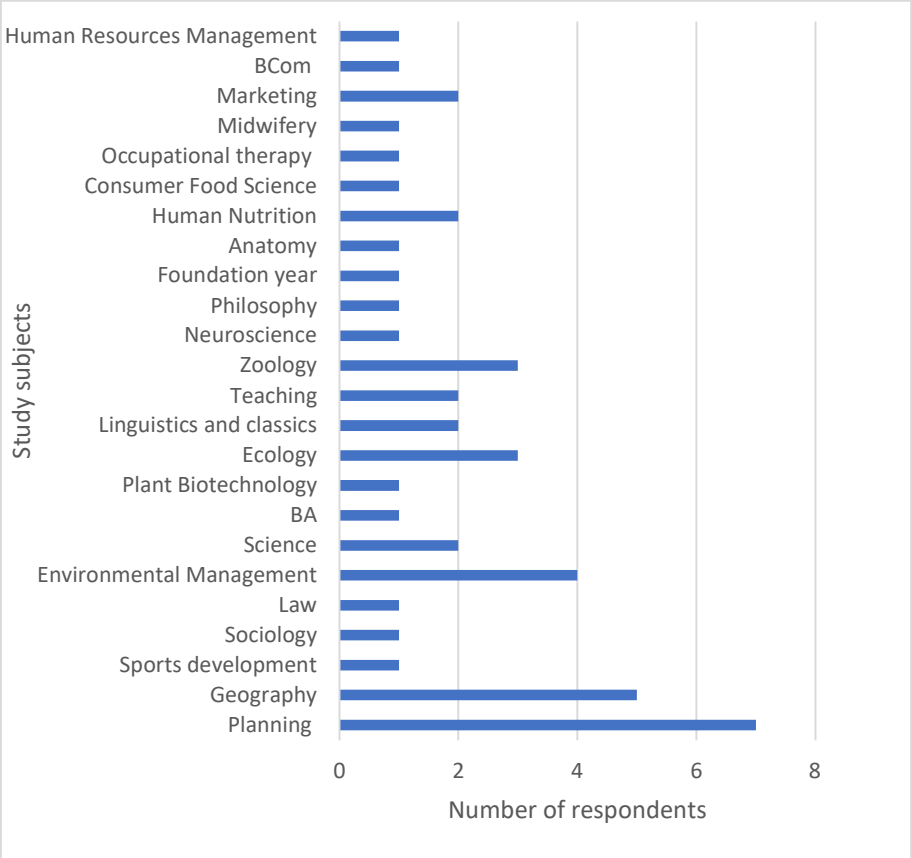

Figure 5.2: Subjects that respondents are enrolled in.

As the literature indicates that large households waste more food than smaller households, the researcher had designed Question 5 to capture the size of respondents' respective households. Figure 5.3 shows that the majority of participants' households have large occupancy rates; out of the thirty-eight respondents who answered this question, twenty-three people live in households with five or more occupants. For this result to be meaningful, it should be read in conjunction with other results revealed through the survey.

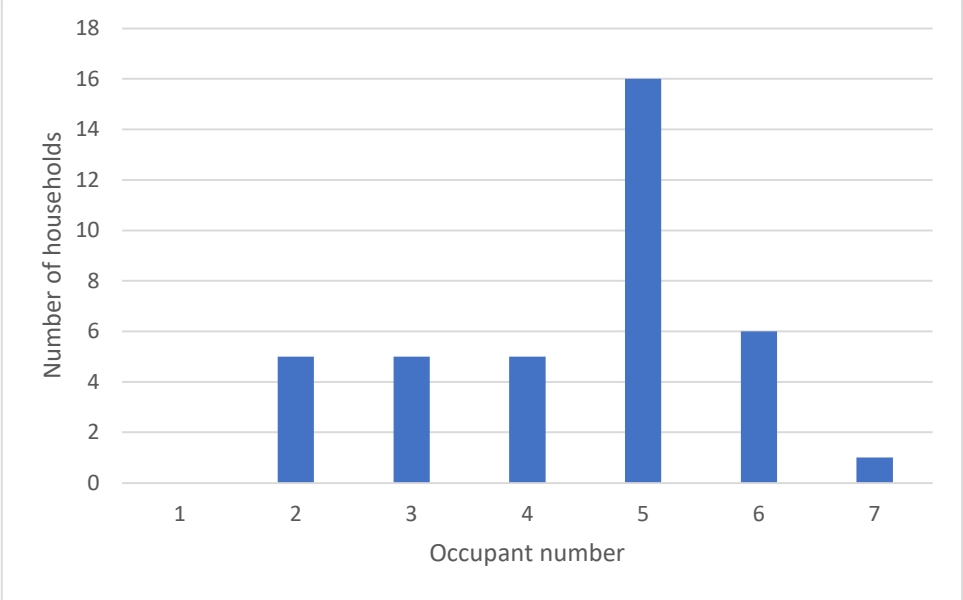

Figure 5.3: Size of respondents' household occupancy

5.2 Food waste minimisation education, focus, engagement, and skills

5.2.1 Survey results

In order to understand barriers to food waste minimisation, it is important to understand common current food minimisation practices. Survey **Questions 9 and 10** solicited information about those practices:

Question 9: What kind of methods does your household use in order to minimise or prevent domestic food waste, if any (e.g., making a shopping list, eating leftovers)?

Question 10: What prevents your household from minimising your domestic food waste?

Figures 5.4 and 5.5 below reflect survey respondents' answers to those questions. The answers reveal that although some people clearly see a need to prevent food waste, an insufficient level of domestic skills and awareness of the food waste issue is preventing

food waste minimisation from being an integral part of household management practices in the precinct.

Figure 5.4 depicts responses to **Question 9**. Thirty-nine people responded to that question. Respondents gave more than one answer each. Eating leftovers to prevent wastage was mentioned 27 times (69%).

> *We try to be creative and use what we have at home for cooking, eat leftovers. or freeze them for later. We try to plan our shopping for the week not to buy too much which will then go bad (Respondent #19).*

Shopping strategies such as writing lists were quite popular at 41% (mentioned 16 times), and 25.6% of respondents said they make an effort to share excess food rather than throwing it out (mentioned 10 times). Food management tools such as meal planning and stock rotation (at 25.6% and 18% respectively) were also regularly mentioned, as was portion management (23% / 9 instances). Bringing lunch from home to prevent wasting food was mentioned 5 times (13%). One household has made the conscious decision to use a smaller waste bin as a tool to remind themselves to waste less. Four households (10%) do not employ any strategies to minimize their food waste and preferring to trust one's own personal judgement over use-by dates was only mentioned once (2.56% of responses). Explanations of the labels used in Figure 5.4 are contained in Appendix J.

Figure 5.5 reflects responses to **Question 10** (*What prevents your household from minimising your domestic food waste?*), which was responded to by thirty-six respondents. The graph in Figure 5.5 shows 17 instances of the lack of composting ability

or greenwaste collection. Readers are here reminded that composting/greenwaste collection are a methods for *managing* food waste rather than to *minimise* it. For that reason, this particular result may not be reliable. The barrier to actively minimizing food waste in the home that appeared most prominently was a lack of pro-environmental engagement in households; this barrier was mentioned 10 times (27.78%). Respondents in this category referred to either themselves personally, the people their live with or the entire household.

> *I try to only cook what I'm going to eat and eat all my left overs but my flat mates don't give a crap about sustainability (Respondent #24).*

Temporal barriers were mentioned as well, including time constraints (mentioned 4 times/11.11%), short-term leases (mentioned 2 times/5.56%), and household members running on different schedules (mentioned 2 times /5.56%), leading to more food waste at home due to separate cooking and shopping routines.

> *We all do individual cooking/groceries and none of us try particularly hard to prevent waste (Respondent #35).*

Five responses (13.89%) stated that their households waste food due to poor stock management (e.g., food in the fridge or pantry is forgotten or not used in time and is thrown out after 'going off'). Two respondents (5.56%) think they waste food because they find it less expensive to buy in bulk, thereby buying more than they need and ultimately throwing out the surplus. Surprisingly, cooking excessive quantities was only

mentioned once (2.78%). Only one household out of thirty-six (2.78%) experienced no barriers at all to food waste minimization.

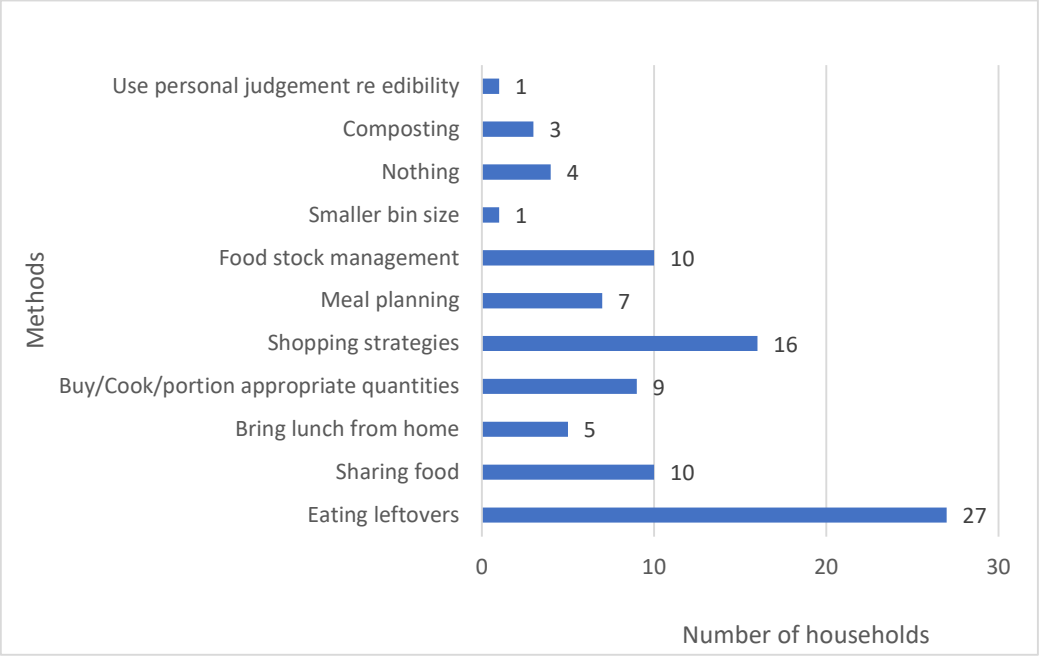

Figure 5.4: Methods used by households to minimise food waste.

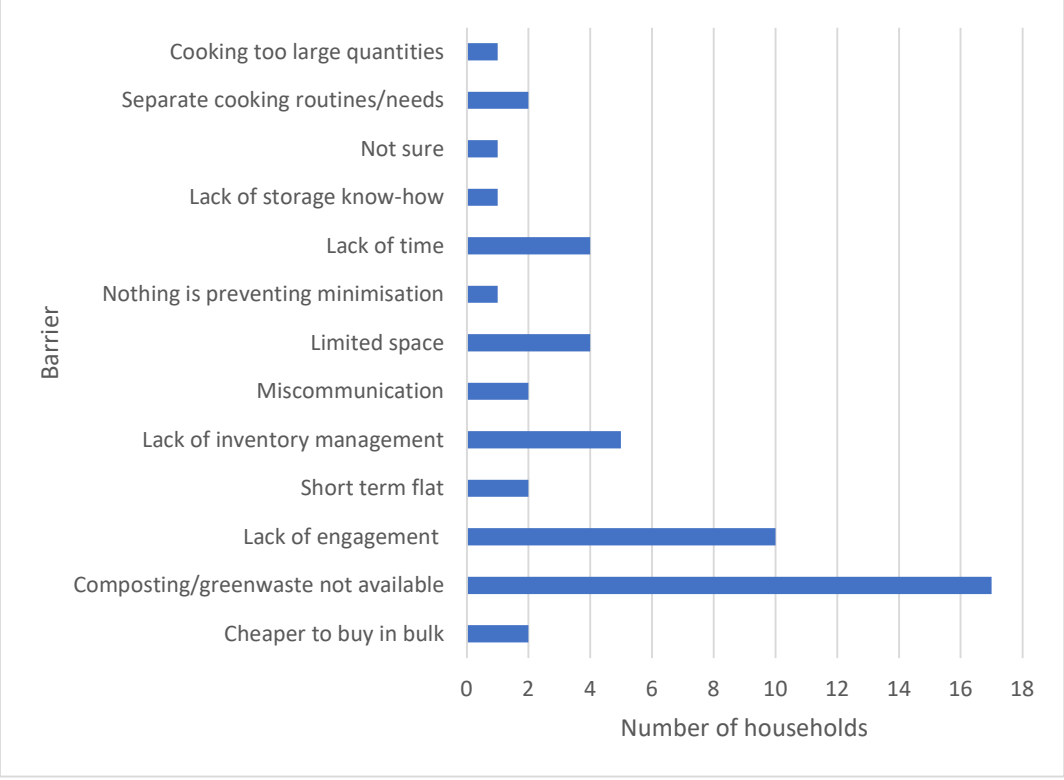

Figure 5.5: Barriers present that hinder households' minimisation of Food Waste.

The activity of composting features in both Figures 5.4 and 5.5. Since the activity of composting is a way to *manage* food waste rather than to *minimise* it, the fact that composting featured as answers to questions 9 and 10 indicates that some respondent may have conflated the meaning of food waste minimization and food waste management, or it could be that the design of the question was flawed. It could also be representation of an inclination in the population to strongly associate food waste solutions with composting rather than with thoughtful shopping and cooking strategies. The educational value of composting should not be ignored, however; the activity of recycling organic material into soil nutrients is a key link in the production of food and may help to influence people's perceptions and values pertaining to food and the environment.

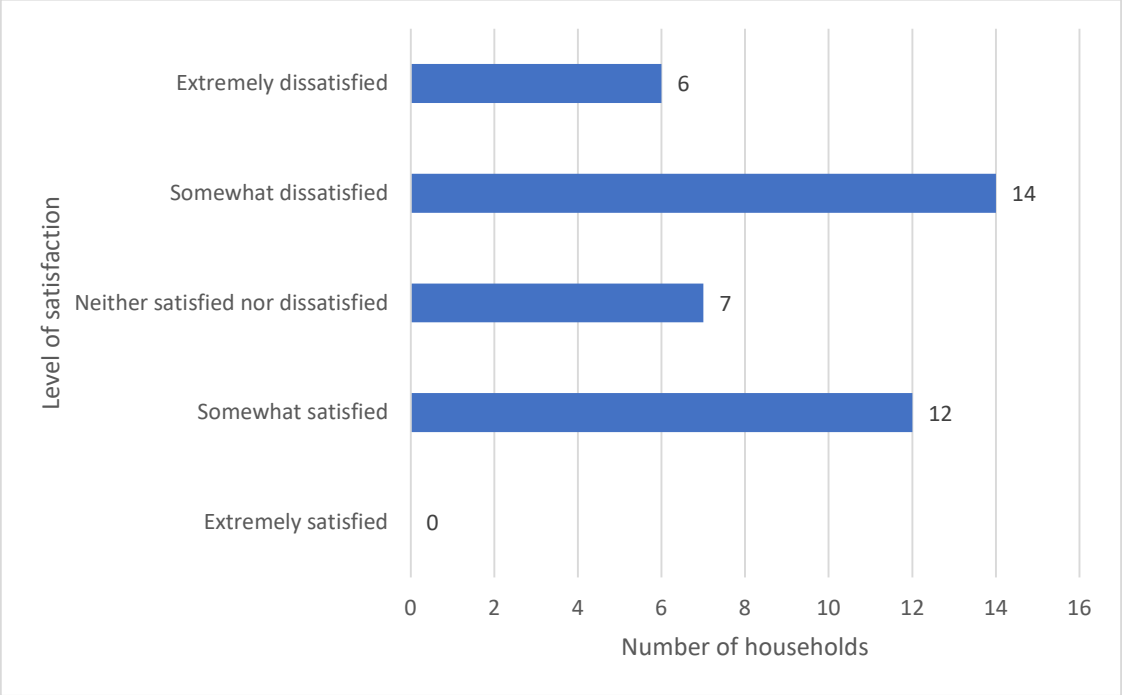

Figure 5.6: Shows households' level of satisfaction with own food waste minimisation ability.

Figure 5.6 shows how satisfied respondents are with their household's ability to minimize its food waste. Responses ranged between somewhat satisfied (30%) and extremely dissatisfied (15%), with the highest proportion of respondents describing themselves at somewhat satisfied at 35 %. Perhaps a deeper meaning to the above results will become apparent when read in conjunction with responses pertaining to how respondents perceive food waste, as explored below.

In **Question 6**, participants were asked to rank food waste-related problem statements in order of importance according to their own views. The purpose of this exercise was to gauge whether respondents were predominantly concerned about food waste's effect on the environment, the city or their own personal affairs. Forty participants responded to this question. Results are depicted in Figure 5.7, followed by commentary.

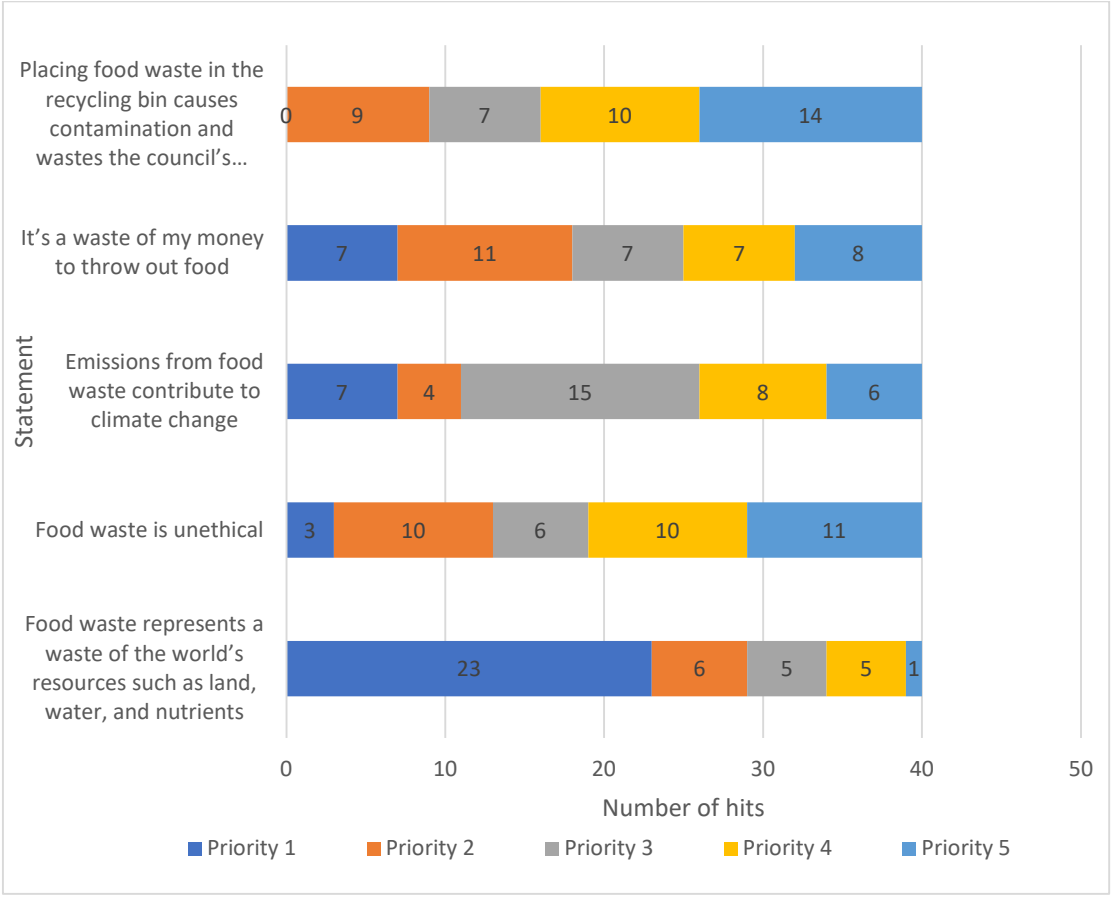

Figure 5.7: Shows priorities assigned by respondents to food-related problems.

Statement #1: Placing food waste in the recycling bin causes contamination and wastes the council's resources.

60% of participants rated this statement as a low priority. This result is consistent with information in the DCC Waste Assessment 2018, where contamination of DCC kerbside recycling bins is listed as a specific problem in this area of the city. The Waste Assessment does not specify the type of contamination that is the most prevalent for this area, but as revealed in key informant interviews (see section 6.4.2), food waste was found to be a significant contaminant of recycling during the skip diversion days (caused

by poor separation behaviour) and it would be reasonable to assume that food waste would be at least part of the contaminants of kerbside recycling bins. This point further supports the need for better auditing data, which was also illuminated during key informant interviews.

Statement #2: It's a waste of my money to throw out food.

45% of participants rated this statement as a high priority. This result may, to a certain extent, support findings through key informant interviews that many residents in the precinct operate on restricted budgets, something that seemed to be strongly linked to 'skip abuse'.

Statement #3: Emissions from food waste contribute to climate change.

Almost 40% of participants rated this statement as medium priority. Considering the large amount of attention that is afforded to climate change matters through the media, political discussions, and popular engagement, this is a surprising result – perhaps reflecting the level of awareness and education in the population around food waste's potential for GHG emissions.

Statement #4: Food waste is unethical.

Over half of all participants rated this statement as low priority. While the question itself may have been superfluous to the questionnaire since the other questions also contained elements of ethics, this result may indicate a gap in people's understanding of the wide-reaching aspects of food waste.

Statement #5: Food waste represents a waste of the world's resources such as land, water, and nutrients.

Over 70% of participants rated this statement as a high priority. Interestingly, this result seems inconsistent with the abovementioned apparent propensity to default to think about how food waste in terms of management (such as composting) rather than how it should be prevented.

One of the last questions of the survey, **Question 17**, asked participants, *what do you think is the most challenging thing about food waste?* This question was aimed at capturing information that had not yet been revealed through previous survey questions and at giving participants a chance to elaborate or emphasize on earlier statements. Figure 5.8 reveals results for this question, which was answered by 31 people. Supporting results from earlier questions and key informant interviews, the lack of resources, know-how and space was mentioned 8 times (25.1%). Five respondents (16.12%) mentioned the most challenging thing about food waste is to engage other people in sustainable food waste-related behaviour. While this result is predictable since it reflects earlier statements by both survey respondents and key informants, it is interesting to note that the difficulty of forming or sticking to new food waste habits was mentioned eight times (25%); this result reveals a self-reflecting factor in the food-waste maze that had not been mentioned much at all during earlier questions. Other factors that may have been expected to rate higher in responses to this question, such as separate routines, busy lifestyles, convenience, and lack of awareness came in at the low rates of 1 and 2 (6.45% and 3.22%). The lack of options to buy food in small quantities was mentioned three times (9.7%) and five respondents (16.12%) mentioned they are prevented from managing their food waste sustainably due to the lack of available systems or infrastructure. One respondent (3.22%), clearly already making an effort to keep food waste out of the landfill, named plastic contamination (e.g., in teabags) as their biggest barrier, and the food waste that occurs in the supply chain was also mentioned once. Two respondents (6.45%) mentioned that they are mostly challenged by the odour that is emitted by food waste.

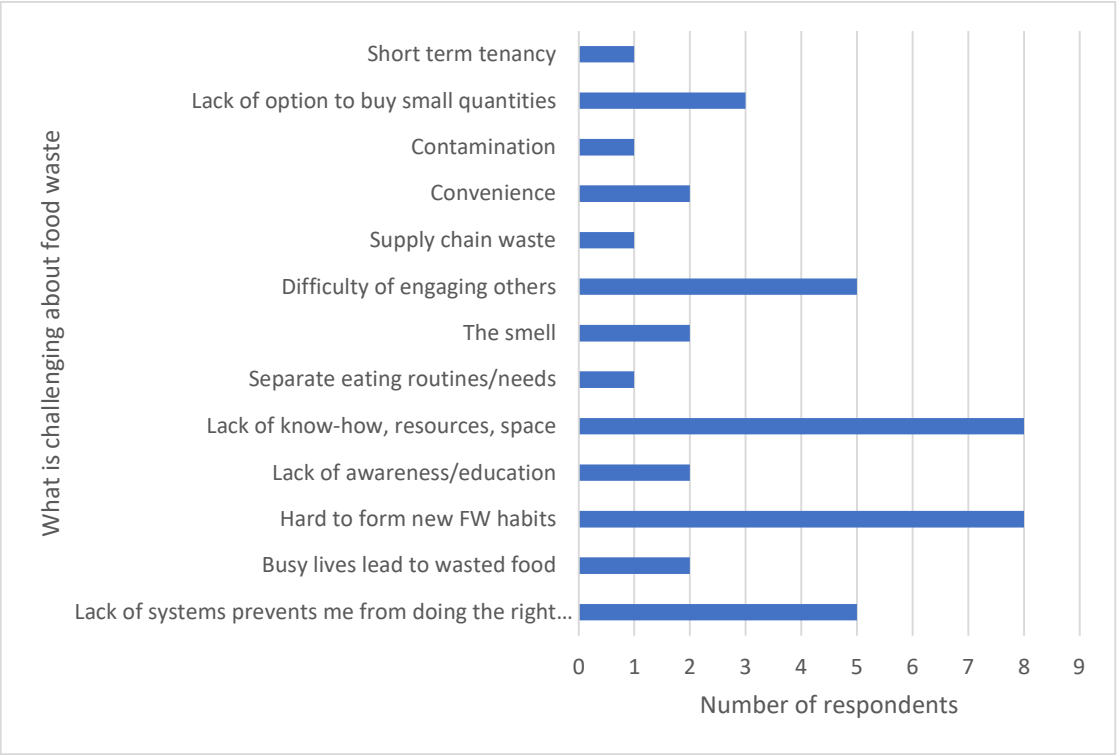

Figure 5.8: Elements that respondents think is the most challenging thing about food waste.

5.2.2 Interview results

There was agreement among all key informants that more education of the student population overall is required to deal with the issue of food waste. Some referred to education about food waste implications and their importance. Other specifically referred to basic domestic skills such as shopping habits, cooking and storing food. This result echoes the results obtained from the online survey, discussed in section 5.2.1 above.

> *I have seen a lot of young students not have like the kind of basic foundational skills, cooking and kitchen work and not knowing much about food preparation and therefore not knowing much about food storage and things so often there's food that goes uneaten and gets thrown out that way (Tertiary education staff member #1).*

Alongside the lack of basic domestic skills, one key informant pointed out that a lot of 'very edible' food gets thrown out by young residents in the area due to a lack of

knowledge about the edibility of different types of foods, and also due to culinary norms of many cultures. For example, cauliflower leaves are edible, but are often discarded as waste.

> *[W]hat we might generally think of as avoiding food waste, which is … making sure that the obviously edible stuff [is eaten]… and then there's the like, educating beyond what is normal. You know, none of my parents or the generation even cooked cauliflower leaves. It's just not normal. And so that is like challenging all of those norms … (Tertiary education staff member #1).*

It was also pointed out that the level of ability to discern appropriate freshness of food is low and that perfectly edible food is often thrown out for being 'off', often out of fear of food poisoning.

> *People have this huge fear food safety and getting sick from it (Sustainability Champion #1).*

> *[T]here's something in that behaviour change that's not quite getting through. How to shop, how to store food so that it lasts for longer, how to do meal plans, you know, all those things. I think that is an incredibly important tool and something that students need to know because they've just left home. And possibly don't know this stuff or living off pizzas (Local government official #1).*

Several interviewees acknowledged the good work that the council's waste minimisation team and agencies such as KiwiHarvest and Love Food Hate Waste are doing to raise awareness, disseminate food waste information, and support community initiatives

through their outreach activities (see Chapter 4 – Dunedin Context and Related Policies for further details). However, most key informants expressed concern that the gravity of the issue is not getting across sufficiently to some groups within the tertiary precinct population, and that more targeted signalling and education could be employed by agencies and institutions. It was suggested that sustainability champions and leaders within the student community would be a valuable resource to tap into, for traction on food waste and sustainability campaigns or projects.

Another barrier to waste minimisation, that at first may seem subtle and yet turns out to be quite fundamental, is the lack of focus on why waste minimisation is so important. A tendency to focus on food waste management rather than food waste minimisation was noted in the survey results (see Section 5.2.1 above). During key informant interviews, it transpired that this lack of focus on waste minimisation is not limited to the tertiary precinct population. Most key informants acknowledged that more focus and resources need to be directed at waste minimisation efforts in Dunedin. One key informant illuminated a tendency at both central and local government levels an 'overwhelming focus' on the management of food waste rather than the prevention of it.

> *I always feel that what's really easy, just because of the types of people that are employed at council perhaps, and just with the energy in the investment of council and the government level, is the overwhelming … focus when - as soon as it comes to waste reduction, it's on the management. And … when we are going to meetings at council, people get really excited about the science of more effectively … converting [to] … diesel or whatever…. (Food waste researcher #1).*

This propensity towards focusing on what to do with food waste rather than preventing it from happening is also not limited to governmental procedures. During the interviews for this research, the researcher noted difficulty in maintaining a focus on minimisation; instead, conversations quickly homed in on the management of waste and the difficulties around managing it, even when the informant was answering a question that was pertaining to minimisation. This shift of focus occurred in around half of the interviews,

and mostly happened so gradually that it was nearly not noticeable - although during one particular interview, the researcher found it very difficult to steer the conversation back to the subject of minimisation due to the interviewee's strong focus on waste management.

Considering how important it is, according to the food waste hierarchy, to focus attention and resources on minimisation rather than management, this observation is worthy of mention as a barrier in itself. If it is difficult for educated professionals with an interest in the food waste issue to maintain focus on minimisation, how difficult must it not be for lay citizens with widely differing interests and direction in life to do the same?

5.2.3 Discussion

The results presented in the preceding section (Section 5.2.2) show that barriers to food waste minimisation exist in the tertiary precinct mostly in the form of lacking food waste-related education and engagement. A lack of awareness of the direct link between food waste and climate change is notable, as is a tension between food safety and food waste prevention. There is also a clear need for improved domestic skills (such as meal planning, food stock management) among the local precinct population.

This finding is consistent with that of Principato et al. (2015) who, in their investigation on food waste behaviour of Italian youths, found that the actual level of food waste knowledge is not sufficient for reducing food waste effectively. Although an awareness of the phenomenon of food waste existed, respondents 'were more concerned about the economic aspects of it than environmental' (p.731). Principato et al. (2017) also found that 'the more aware youths are concerning the negative effects of food waste, the more likely they are to reduce leftovers. In contrast, the concern about food freshness increases waste. A greater awareness of the consequences of food wasted increases the likelihood that youths will make a shopping list' (p.731).

Another interesting barrier uncovered in the precinct and permeating into the wider society, is a failure to assign sufficient importance to waste minimisation. Conversations on food waste often default to composting and technological solutions, leaving the topic

of minimisation in a mist of silence. When recalling the priorities of the Food Waste Hierarchy and the importance the European Union is now placing on the prevention and minimisation of food waste (as discussed in Section 2.3.1), the disproportionate focus on food waste management in Dunedin (at the expense of food waste minimisation) that this research has uncovered justifies a suspicion that New Zealand has some distance left to cover in the fight against food waste awareness. The Mirosa Report (2019), points out that the concept of waste minimisation is already familiar since the traditional Waste Hierarchy is already embedded in the New Zealand Waste Strategy (2010), the Waste Minimisation Act (2008), and territorial authorities' waste management and minimisation planning processes. However, the report recommends the development of a specific national food waste reduction strategy, adopting a circular economy approach and placing the highest priority on the prevention of food waste in the first place (Mirosa, 2019). A national strategy such as this should help to bring the importance of food waste minimisation to the fore although, as is still the case in the UK (Mirosa, 2019), it may take time for full understanding of this prioritisation to trickle through to all factions of New Zealand society.

The Mirosa Report also recommends targeted food waste education efforts, both at school level and through food waste prevention initiatives such as 'Love Food Hate Waste'. The need for more education around food waste-related domestic skills, edibility, shopping habits, storing, and cooking food is a topic that surfaces frequently and is well supported in the literature (Principato, 2018; Principato et al., 2015; Tucker & Farrelly, 2016a; von Massow et al., 2019; Watson & Meah, 2012). As stated by Tucker & Farelly (2016), 'the most critical aspect of food waste avoidance in wealthy nations such as New Zealand at a household level comes down to improved food-related planning and management' (p. 686). One of the most widely used tools to influence rates of food waste prevention and reduction is information campaigns (Schanes et al., 2018). Information platforms and door-stepping campaigns can lead to meaningful behaviour changes, as has been demonstrated through long-standing campaigns such as 'Love Food Hate Waste' (Schanes et al., 2018). However, although appraisals of food waste minimisation policies are scarce (Thyberg & Tonjes, 2016), the literature suggests that, in order to be effective, educational campaigns must 'address the specific knowledge gaps that drive

wasteful practices' (Schanes et al., 2018, p. 986) in an area; simply referring to the broad subject of 'food waste' may not produce meaningful results.

Here it is important to also reflect on the apparent juxtaposition of interests between education of food waste prevention and commercial food interests. Food retailers are in a 'unique position to influence household behaviour for the better' (Department for Environment, Food and Rural Affairs, 2006, p. 36) but they are also in the business of selling food at a profit so why would they encourage people to buy and use less food? It is widely accepted that 'food marketing and retailing contribute to consumer-related food waste via decisions on date labelling, packaging sizes and design elements, and pricing strategies … as well as communication shifting consumer priorities to the disadvantage of food waste avoidance' (Aschemann-Witzel et al., 2016, p. 271). Despite a prevalent climate of neoliberalism however, some food retailers in New Zealand are slowly following the overseas industry trend of voluntarily committing to adherence of the food waste hierarchy by reducing food waste both in their own operations and encouraging customers to do the same (*Countdown on Food Waste*, n.d.; RNZ, 2020; Swaffield et al., 2018). This trend has partly come about through external pressures from consumers and social movements. It appears to earn retail businesses both moral and social credit, but is nevertheless met with scepticism about the motivations of large businesses. For example, Gille (2012) 'argues that retailers have often been able to reduce the waste attributed to their direct operations through the exploitation of suppliers, particularly those in the global south' (Gille, 2012; Swaffield et al., 2018).

Factors that influence waste prevention have been linked to cultural norms and national circumstances, can therefore differ between localities (Thyberg & Tonjes, 2016). Thyberg & Tonjes (2016) suggest that policy measures to address food waste such as educational campaigns should be simultaneously holistic and tailored - addressing values, skills and logistics while integrating community needs for each situation. Such programmes, if well managed, monitored, and evaluated, can then produce valuable data that can be used to inform new waste prevention programmes in other areas.

In line with this sentiment, results from Campbell-Arvai's (2015) study on whether environmental sustainability is a consideration in tertiary students' food choices suggest that educational campaigns could 'focus on strengthening beliefs about the food-environment connection, as well as help to empower students to take a greater variety of actions to reduce their food-related environmental footprint' (Campbell-Arvai, 2015). Results from the survey presented above, indicating a relatively low understanding of food waste's contribution to GHG levels, shows that such an approach may be appropriate in the tertiary precinct.

Food waste prevention policies cannot rely solely on education campaigns, however (Thyberg & Tonjes, 2016). Current sociological research shows that consumer behaviour is largely 'largely driven by social norms of appropriateness' (Evans, 2014; Lake et al., 2020, p. 195) and challenges assumptions that 'individuals are "autonomous architects" of their own food purchases and food waste' (Evans, 2014, p. 17; Lake et al., 2020, p. 195). To induce behaviour change in an area where attitudes and values are deeply embedded through repeated reinforcement over time such as the tertiary precinct, deep and reiterated outreach and engagement is required (Connelly et al., 2011). The issue needs to be addressed from multiple angles simultaneously, such as in coordination with the roll-out of new infrastructure, regulations or services (Thyberg & Tonjes, 2016). This is valuable insight for policy makers and social marketers that aim at behaviour change in the tertiary precinct: for domestic food waste minimisation to find its way into the agenda and focus of households, education and outreach in the area would need to be targeted and relatable, yet strategic, well-timed, long-term and part of a multi-pronged programme. Importantly, due to the high turnover of residents in the area, the message of the importance of food waste minimisation would also need to be perpetually reiterated.

5.3 Lifestyles

5.3.1 Interview results

Two key informants underscored that students' lifestyles could well be seen as a barrier to food waste minimisation among households in the tertiary precinct. It was pointed out that students generally work and study hard, and that their busy lives deliver experiences

in terms of provisioning and cooking that are different to what most expect in an average family setting. One key informant, who has direct insight into students' worlds through course-related material, confirmed that in recent years cooking arrangements in shared flats have changed from a culture of communal 'flat cooking' to individuals cooking for themselves separately. Although communal kitchens are still the norm in shared households such as student flats, increasingly different dietary requirements (such as gluten free and vegan) are now making it more difficult for students to cook communally. An increased rate of studio apartments, housing just one or two persons per unit, is also believed to add to this trend. This shift is believed to have a direct impact on the way households shop for food, the space available for storing food, and the way that food is disposed of – ultimately having the effect of increased generation of food waste.

> *I can see that it's changed. A lot less communal cooking, which then has an impact on food waste, because cooking for an individual, or, you know, a couple or something - is quite a different setup, I guess. You know how it all works. It's much more independent than if you [do a] big flat cook. And possibly busier in the kitchen and you know, everyone's doing their own. ... It has implications for how much food you can store and how the shopping's done and all those sorts of things. And also the disposal of food. Also, you know, people are having increasingly different dietary requirements in terms of gluten free and veganism and all those sorts as well. So, it's a lot more difficult for students to cook communally than it has been (Food waste researcher #1).*

Statements from a second key informant emphasised the importance of the demographic composition of shared households in the precinct. The fact that decisions in a student household are normally made by individuals rather than by a family unit can be interpreted as a barrier to sustainable practices in itself; an individual in a flat normally has no control over the waste behaviour of the other people in the household and consequently one person's good practices can easily be negated by other household members' behaviour. For example, meticulous adherence to recycling rules by one person amounts to nothing if that person's flatmate then throws a pint of mouldy soup

into the same recycling bin, since the whole bin would therefore be deemed contaminated and everything would go to landfill.

> *My interpretation is that most flatting situations we can't treat in the same way as we would a household with a family. Normally, all the decisions are made by individuals rather than a family unit. So, an individual and a flat has no control over the waste behaviour of the other people in the household. So probably the - I don't know - perhaps your study is focused on reducing the amount of food waste or doing something with it. But actually, one of the biggest problems we face with food waste is how it pollutes other recycling (Tertiary education staff member #2).*

One informant drew a direct parallel between the precinct's waste issues, low average demographic age, and results from the WasteMINZ food waste study:

> *The NZ wide avoidable (could have been eaten) food waste research of some 6 years ago identified the most likely sectors of the population who might waste food. One group was the 16-24 year old age bracket of which has a direct correlation to the tertiary area. The challenges for this sector I identify as choosing the right platforms in order to get message out, keeping up with those education initiatives and understanding the contributing issues to why food waste might be happening. I'm always very conscious that budget constraints can play a part (Local government official #4).*

One key informant did not think that a busy lifestyle constituted a barrier to food waste minimisation. Rather than pointing to time pressure, the informant felt that waste habits in general come down to values and outlook.

[C]ontroversially, I would argue that you're not too busy. Because … I am a really packed up person. I'm doing stuff from 9 to 5.30 today and I'm still doing stuff in the evening. And yet, I live fully zero waste. Me and my partner do. It's not like it takes me extra time. It's just changing the mindset from like, all convenience - so your noodles – like, no, I don't actually need noodles, I'll just get pasta from Bin-in. So, when we moved to zero waste, the whole ethos was 'we're going to eat the same as we did before we wasted. We'll find alternatives'… So, we just wanted to change that we had no waste, and we just found the alternatives for it. And in doing that, nothing's changed. Like, I still eat exactly how I did last year. … I've had no waste. I still have a bit busier timetable this year, actually. We still do it. So I'll just say people are lazy (Sustainability champion #1).

When prompted, key informants were aware of food sharing apps in general, but none were informed on whether this technology is being used in the tertiary precinct.

5.3.2 Discussion

As shown in Figure 5.5 (Barriers present that hinder households' minimisation of food waste) and Figure 5.8 (Elements that respondents think is the most challenging thing about food waste), a lack of time does not feature very highly as a barrier to food waste minimisation for some residents in the tertiary precinct. The above results indicate that other elements of tertiary precinct residents' lifestyles present more substantial barriers. Differing individual diets, schedules and levels of environmental engagement featured as notable barriers, as did the difficulty in forming new habits. Considering that a large percentage of households in the tertiary precinct are shared 'flats' with high rates of occupants, each with their own individual schedule, it is not surprising that households are finding it challenging to coordinate meals and food shopping. Add to that mix different dietary requirements and limited space to store specialist ingredients, and the result could potentially be a logistical nightmare. Data from the 2015 WasteMINZ National Food Audit supports this conjecture; it suggests that the number of occupants in a New Zealand household has more effect on waste generation than the age of the

inhabitants, although households with older inhabitants tended to waste less (Waste Not Consulting, 2015).

Whether, and how high, the prevention of food waste features on shared households' priority list could come down to a myriad of factors. Just a few of those could potentially be personal economies, ethical standpoints, social norms (Tucker & Farrelly, 2016a), habits (newly formed or inherited from home) and even, as shown in the results above, the level of ability that environmentally-conscious residents have to persuade their flat mates to 'join the cause'.

Research on how the context of daily life influence young people's sustainable behaviours is limited. However, Skinner et al. (2012) have produced an insightful analysis on how the overlapping spheres of work, home and community affect our capacity to live sustainably. They state that 'it is the interaction between the contexts of everyday life – work, home and community – and the broader factors of life – stage, space, time and power – that constructs both the willingness and the capacity to live sustainably' (Skinner et al., 2012, p. 38). Those findings support Evans' (2011) argument that food waste arises 'as a consequence of households negotiating the contingencies of everyday life' and that it seems 'perverse to position food waste as a matter of individuals making negative choices to engage in behaviours that lead to the wastage of food' (Evans, 2011, p. 438). This point illustrates an important sociocultural area where waste minimisation strategies could strengthen their focus.

The undeniable power of habits should be noted here. Principato et al. (2018) identify habits (such as always writing a shopping list) as a powerful leverage tool to enable consumers to reduce their domestic food waste. Dealing with food is something we all do every day to various degrees, and the habits we form around this fundamental building block of our existence, whether they are inherited from our home culture or not, can be set very deep. Educational campaigns are widely used and are a definite must in order to raise awareness of environmental issues, but they are not enough to tackle barriers to domestic food waste minimisation by themselves; we need to go deeper than that (Gifford, 2014). As has been shown substantially in the literature, environmental concern and awareness does not always translate to environmental action.

There is a strong link here to the theory of the awareness-action gap (also labelled the 'green attitudes, brown behaviour paradox'), as discussed in the literature review (Blake, 1999; Evans, 2011; Kollmuss & Agyeman, 2002; Skinner et al., 2012; Tucker & Farrelly, 2016a). Perhaps, in order to change not just individual habits, but also the habits of the population, we first need to examine how we as a society value and relate to food, and, as argued by Hawkins (2006), also how we relate to waste. A 2012 study on the environmental attitudes, knowledge, intentions and behaviours among university students in USA suggested that knowledge and explicit attitudes can both result in pro-environmental behaviour although through separate pathways and that behaviour change interventions targeting both knowledge and explicit attitudes should be using different mechanisms (Levine & Strube, 2012).

As results presented in this thesis thus far indicate, there is significant scope for levels of food waste education and engagement to be improved in the tertiary precinct. The results also show that lifestyles, habits, and values are also important parts in the food waste puzzle. Any behaviour change campaign plans for this area would need to take the influence of these elements into consideration. Behaviour change strategies work on many different levels: through education, prompting and rewards, through local champions, through changing regulations, schemes that elicit public commitments and feedback, and even 'provision of smaller resource territories for which individuals feel more responsible' (Gifford, 2014, p. 490). An integrated, long-term, and well-planned behaviour change strategy could be a valuable addition to existing efforts for changing waste-related behaviours in the tertiary precinct, when used as part of a multi-pronged approach as discussed above (see Section 5.2.3). The topics of local sociocultural variables and values will be further explored in the next chapter: Barriers to sustainable food waste management.

5.4 The built environment

'What we see, do, think, plan and feel are partly a function of the various natural and built setting surrounding us. Our well-being and that of the environment depends on mutual transactions between ourselves and the settings in which we live, work, study,

and visit' (Gifford, 2014, p. 7). This summary by environmental psychologist Robert Gifford is not intended to deny the importance of the many other factors that influence us (e.g., upbringing, beliefs, culture, laws) but it is an important reminder of the profound inter-relationship between the built environment and the people that spend time in it.

This section will examine how the built environment has an influence on local residents' ability to minimise their domestic food waste. It will address **Research Question 1B**: *How does the built environment influence residents' ability to minimise their domestic food waste?*

5.4.1 Survey results

Question 13 asked participants to indicate whether they think the built environment prevents them from minimizing their food waste. Nineteen out of thirty-six people (52.78%) answered 'yes' and seventeen (47.22%) answered 'No'. However, when respondents were asked in **Question 14** to explain how the built environment hinders them, all responses (of which there were 24) pertained to food waste management rather than food waste minimization. As discussed previously, survey respondents seem to have conflated the meaning of the terms food waste minimisation and food waste management. Results from **Question 13** are therefore not reliable, as it is likely that many respondents confused food waste minimisation and management as meaning the same thing. However, if the reason why participants responded in this way was due to them not sufficiently understanding what is meant by waste minimisation, then that would be a meaningful result in itself and would support the claim in section 5.2.3 above that there is a need for more information dissemination and focus on food waste minimisation in the area (and beyond). This also highlights that there are opportunities for introducing signalling into the built environment that may encourage higher levels of appreciation of the importance of food. Edible verge gardens, for example, provide unique 'opportunities for encountering and learning about food cultivation and consumption practices at the mundane level of the footpath' (Hsu, 2019).

5.4.2 Interview results

Both the group interview and individual interviews produced more insightful results. When asked about perceived barriers to food minimisation in the tertiary precinct, one key informant maintained a strong focus on the types of affordable food outlets that are available in the area. This informant acknowledged the local demand for easily available and affordable ready-made meals but was concerned that the majority of takeaway food on offer locally is so-called junk food rather than healthy, nutrient-dense food. This person suggested that the provision of more community-based spaces for growing food, increased education on healthier eating and waste minimisation, and also a higher proportion of nutrient-rich, high quality (yet affordable) takeaway food on offer in the area would have a positive effect on the value that local residents place on food and, consequently, the volumes of food wasted by them.

> *They need some sustenance when it's late at night so they're grabbing for easy prepared meals and we're not providing them with homemade delicious meals. The easiest thing that's there for them are the cheap, crappy things like the McDonald's. ... So I think there's a whole niche around, pre-prepared, homemade meals ... nourishing and not exorbitantly priced but that's a whole different area. … [T]he layout of ... that whole area ... is laid out in terms of thinking about food outlets, in my mind. I think it's really focused on the fast food and nothing else. And I think that's a problem. And I think there's no little - for anyone who does want to grow - no little community growing spaces that anybody does have the energy or the know how well they want to do something (Sustainability expert #1).*

This link between food waste and the availability of fast food in the area also surfaced as a topic during the group interview. One interview participant explained how three of his flat mates are sent money from their parents every week. With the intention of eating healthy, these flat mates routinely buy fresh groceries at the supermarket. Those groceries, however, also used to be routinely left, uncooked, in the fridge 'to rot' in favour of 2-minute noodles or takeaways.

To get to my flat from uni, you have to walk past McDonald's, pizza places, Dominoes, KFC, everything. So it's very easy just to think 'I'm just going to grab something on the way home'. 'Cause they're thinking about food just to be 'not hungry'. And then they get home and rather than thinking of food they're just like 'I can just relax'. And then everything in the fridge that they bought just goes to waste. .... It's like people only want to eat just to be 'not hungry'. There needs to be a reduction in the amount of fast-food outlets available so that it's not as easy to be like, 'ah, I'm just gonna grab this on the way home'. Maybe it could be 'hmm I've got this stuff in the fridge at home, maybe I can just do a quick something for dinner' (Group interview participant #3)

The same informant then explained how the COVID-19 Level 4 lockdown in 2020 had had a profound impact on his household's cooking habits and his flat mates' cooking skills – to the extent that they now purchase 75% less takeaway food, resulting in fewer ingredients being wasted. When asked whether he thought his flat mates had the skills required to cook the food they purchased every week, he responded:

I found over the Level 4 lockdown, because there was nothing open, we were literally forced to cook our own food. So, by the time it was over, ... they started realising that actually, 'I can do it - it doesn't matter if it's questionable, just chuck a bit more salt on it' and then, since they didn't have the option of fast food, they started realising how easy it is to just get something out of the fridge and cook it up.

...

Then we discovered, after lockdown: who's going to be the first one to give in and get the takeaways? But we lasted at least six weeks, which none of us ... you know, there were three of our flatmates that rely on fast food, but they didn't want to be the ones to give in. And since there were three or four meals that they had got good at cooking during lockdown, they thought, 'I'm just going to keep cooking these' (Group interview participant #3).

Tight living conditions were also pointed out as possible barriers to food waste minimisation in student flats – both the density of residents per household, and the lack of storage for food. Insufficient fridge-space was pointed out as an issue which has become compounded with increasingly different cooking routines, as mentioned earlier. A lack of storage for everyone's food can lead to crammed conditions, causing items to be forgotten about and spoiling before it is 'rediscovered' and eaten.

> *I know a major thing that came out of our interviews as a barrier in the home is around storage - and space in the fridge in particular. Especially when people have different cooking routines and things. It becomes a very small amount of storage for a large amount of people and the stuff gets lost. And again, there are some really simple solutions to helping manage that sort of thing that I guess council could provide: stickers or something – "use these first" and all those sorts of things (Food waste researcher #1).*

5.4.3 Discussion

According to the results above, both the amount of fast-food outlets in the area as well as insufficient food stock storage space lead to roughly the same result: food spoiling before it is eaten – either because it is forgotten about, or because cooking it seems too difficult or time consuming. These scenarios could be described as barriers to food waste minimisation caused by the built environment – or at least the way some residents interact with elements of the built environment.

A correlation between fast food and domestic food waste is already documented in the literature. Evans's 2011 study on the dynamics of domestic food practices in the UK is notable: just as in the results above, household food in Evans's study 'gets displaced and wasted as a result of a mismatch between the food that is provisioned and the food that is eaten within a given period' (Evans, 2011, p. 436). In both of Evans's studies, one could be forgiven for assuming that the purpose of buying fresh ingredients is to take it home, allow it to decay slowly in the fridge, and then to be thrown out. Although the

circumstances differ, the scenario described above by Group interview participant #3 echoes that of one of Evans' key informants: when away from home, hunger strikes and the contents of the fridge is forgotten about, convenience food is an immediate and available option that is often hard to refuse. Meanwhile, the food in the fridge remains, where it continues to decay. When seen in this context, one could indeed argue that a built environment with a high concentration of fast-food outlets can act as a barrier to food waste minimisation. This argument is strengthened when considering the result above (Section 5.4.2), where food waste was reduced as a result of the unavailability of fast food during the COVID-19 lockdown.

Mallinson et al. (2016) have found strong linkages between household food waste and young consumers' reliance on convenience food (Mallinson et al., 2016). However, there appears to be a gap in the literature on whether different *types* of convenience foods have different effects on household food waste. Further research into this niche topic would be required for any confirmation could be offered on whether reliance on convenience food will lead to less food waste if that convenience food is healthy.

Again, we can draw a link back to the value-action gap. Households are showing good intentions to eat 'properly' (Evans, 2011) by habitually buying fresh ingredients that are at risk of decay and wastage. But, due to a myriad of reasons, those intentions are not carried through. This research has shown how convenience food outlets within the tertiary precinct can be added to the list of barriers that residents may need to contend with (whether consciously or unconsciously) in order to successfully minimise their domestic food waste.

5.5 Conclusion

This research adds to existing literature on domestic food waste experienced by young people and people in large households. It also provides interesting results relating to the influence of the built environment. Although the response rate for the online survey was not as high as expected and the responses to one of its questions may need to be disregarded due to a potential misunderstanding, the survey still revealed some strong

trends and also in many places supported information revealed through key informant interviews.

Survey and interview results show that sufficient focus on food waste minimisation is lacking, both within many tertiary precinct households and, to a certain degree, private sector professionals, tertiary institution staff, and local government officials. It was found that this lack of focus on food waste minimisation, lack of domestic skills (such as cooking, storing, planning and the ability to discern edibility) and low level of education on the impacts of food waste present as barriers to domestic food waste minimisation in the tertiary precinct. Some of the uncovered barriers, (such as the lack of education and domestic skills) may have been relatively predictable. More surprising were the ways in which demographic factors such as occupancy density and lifestyle trends and dietary requirements are having an impact. Quantitative data would be required to establish just how much effect these differing factors have on households' food waste minimisation ability.

A central theory in the discipline of environmental psychology is that people are substantially influenced, both directly and indirectly, by the environments in which they live, work and play. Going by that premise, the built environment-lens that was incorporated into this thesis is justified when examining barriers to sustainable food waste practices. Through that lens, the research results have been able to point to a strong correlation between the availability of fast-food outlets in the precinct and whether food goes to waste in domestic residences. It was also found that insufficient food storage space may contribute to food waste at home. These barriers to food waste minimisation can be directly linked to the demographic situations of high occupancy rates in shared homes, emergent lifestyles, dietary requirements, as well as the built environment. These findings are valuable additions to the food waste literature.

This study shows that barriers to domestic food waste minimisation in the tertiary precinct are multi-layered. They can be subtle or direct; they can be found in the social and intellectual realms just as they can in the physical. By reminding us how important education and skills are in terms of empowering domestic residents to minimise their food waste, the results presented in this chapter also remind us that food waste is a deeper,

societal problem which requires wide-reaching, multi-pronged, systemic, and longitudinal solutions.

Chapter 6: Barriers to Sustainable Domestic Food Waste Management in the Tertiary Precinct

Despite many people's efforts to avoid food waste, the fact remains that both avoidable and unavoidable domestic food waste is still created in Dunedin, and it is still going to landfill. Based on June and September 2018 audits, The Waste Assessment for Dunedin estimates that an average of 13.44% of the waste going to the Green Island landfill is 'kitchen organics' (Dunedin City Council, 2018). How that food waste is managed is an important topic. Sending food waste to landfill is an available, but unsustainable option which would not be in accord with zero waste principles (Lehmann, 2012). As results from this study show, however, many households in the tertiary precinct are either not willing to, or able to, divert their household food waste from landfill. The barriers at play here are various and often overlapping.

The present chapter examines existing barriers to sustainable domestic food waste management practices in the tertiary precinct. Specifically, this chapter addresses **Research Question 2**, which is:

2A: What are the barriers to sustainable food waste management practices among households in Dunedin's tertiary precinct?

and

2B: Does the built environment influence residents of the tertiary precinct's ability to manage their domestic food waste sustainably?

The findings are grouped into three main themes that emerged from the research. Firstly, barriers associated with socio-cultural conditions in the precinct will be presented and discussed. The chapter will then move on to examine the built environment and barriers created in that dimension. Lastly, the chapter will examine how a lack of infrastructure, support and services forms an additional layer of barriers for residents in the tertiary

precinct to manage their domestic food waste in environmentally responsible ways. For each theme, results from the primary research that was undertaken are presented first. The results are then discussed.

6.1 Socio-cultural barriers

This section will address **Research Question 2A**, which is: '**What are the barriers to sustainable food waste management practices among households in Dunedin's tertiary precinct?'**

6.1.1 Survey results

In **Question 12**, survey participants were asked to reveal what hinders them from keeping food waste out of their households' weekly rubbish bag. Results to this question are depicted in Figure 6.1 below.

For the purposes of this section, attention is drawn to the results showing that 15.4% of respondents have trouble engaging others in food waste management or find their flat mates' lack of willingness to engage a barrier. It is also worth noting that that 5.13% find the inconvenience of food waste management activities a barrier. These results reflect results discussed in Section 5.3 above, strongly indicating that difficulties in forming new habits and a lack of engagement with food waste as an environmental issue are important barriers to sustainable domestic food waste practices in the tertiary precinct.

Most of the remaining responses to **Question 12** pertain to the built environment and other factors rather than socio-cultural conditions and will be discussed in Section 6.3 below.

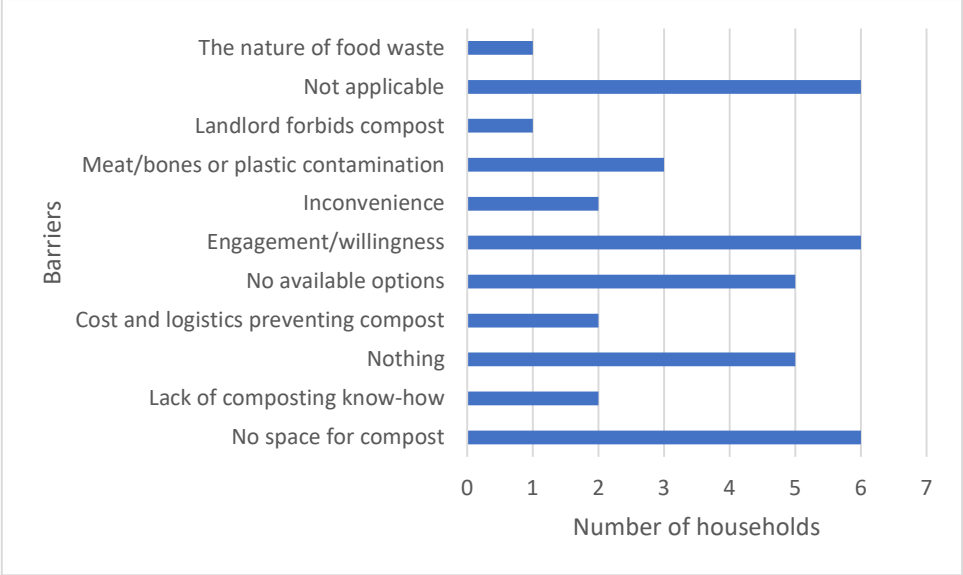

Figure 6.1: Barriers to sustainable food waste management.

6.1.2 Interview results

Results from the key informant interviews and group interviews also suggest that a lack of engagement with domestic food waste can be seen as a barrier to sustainable food waste management in the tertiary precinct. They also suggest that demographic trends, such as population transience and low average age, also play an important part.

All key informants acknowledged that the transient nature of the student population in the precinct affects students' willingness and inspiration to take part in composting activities. It is widely known that students often only stay in the same dwelling for one year at a time. At the end of that year, they are likely to either move away from the area altogether or find a new flat for the following year. At the end of the academic year, a large percentage of students leave and do not return to Dunedin before the next academic year starts. This high turnover in terms of residents living in the same space year after year is disruptive to household routines and knowledge about local services and regulations, preventing continuity of habits and long-term projects such as growing food or composting. Two key informants pointed out that the frequent moving between dwellings is also prohibitive for individuals who wish to engage in gardening; it could take quite a bit of time and effort to get a garden established, and the academic year finishes just as the growing season takes off, so what would be the point?

While it was clear from the key informant interviews that a good proportion of the residents in the area are made up of environmentally conscious individuals, it was equally evident that many other residents do not appreciate the issue of domestic food waste or simply do not wish to engage with it. This apparent apathy is not limited to food waste – domestic waste issues and high levels of littering in the area are well known and documented, as outlined in the Dunedin Context and Related Policies chapter (Chapter 4). There was agreement among informants that these waste issues, which have been of concern to local government and civic society for many decades, are related to a deeply entrenched culture of low care and rebellion in the area (as outlined in the Dunedin Context and Related Policies chapter – Chapter 4).

Three key informants indicated that they, to a certain extent, regard the relatively low average age of the precinct population as a barrier to them engaging in sustainable waste habits. These informants referred to the adolescent/young adult age as a stage in life during which it is common for individuals to stamp one's independence by resisting social responsibilities; rebelling against norms, rules, and policies; and when personal economies can be strained.

> *If we look at the average age of the student community, we all go through a stage in our life where we want to stamp our independence at that point. And being told what to do through policy and rules is an opportunity to start that independence by doing something different (Tertiary education staff member #2).*

Another informant remarked that some students who come to Dunedin to study expect to find a slum-like, low-amenity area and the alcohol-infused, rebellious lifestyle that Dunedin student life now has a reputation for. The same key informant also drew parallels between the precinct's overall waste challenges and similar challenges often seen in culturally and socioeconomically deprived areas elsewhere. This informant explained that the combination of an expected 'trashiness' of the area plus very little social or cultural pressure to engage with wholesome and sustainable restorative practices acts as a self-fulfilling narrative that translates through as barriers to sustainable waste

habits, including food waste management. This cultural backdrop in a littered urban environment that signals a lack of care and maintenance makes it unrealistic to expect individuals to take the initiative to process their own food waste without support and impetus from community engagement on multiple levels. It also makes it difficult for those individuals who are already engaged in environmental concerns to commit to sustainable domestic practices if there is a high likelihood of their efforts to have no impact or to even be undone by other residents in the area, often prompting a sentiment that there is very little point in even trying:

> *You know, "why should I bother to try to make a worm farm in my backyard when there's glass all over the street?" (Tertiary Staff #1).*

Paired with the absence of food-waste specific infrastructure as discussed in the Dunedin Context and Related Policies chapter (Chapter 4), one can discern how food waste-specific issues in the precinct are nearly inextricably intertwined with the precinct's complex and multi-layered general waste issues. An indication of this is how easily interview conversations slipped into talking about the area's overall waste and littering issues, even when the topic of discussion was food waste. This sentiment was echoed by several other informants. For example, one key informant recalled consistently being told by environmentally minded students that being the only 'greenie' in the flat can be quite a socially isolating experience, which in itself is perceived as a barrier.

6.1.3 Discussion

The results presented above suggest that socio-cultural factors appear to affect precinct residents' ability and willingness to engage in sustainable food waste management practices. Age, population transience and littering norms came through as particular barriers.

6.1.3.1 Age

Early studies in environmental psychology indicate a link between age, environmental concern, and environmental behaviour. Older people 'report engaging in more pro-environmental behaviour than younger people' (Gifford & Nilsson, 2014, p. 146). Interestingly, however, most research shows that younger people 'report being more environmentally concerned than older people' (Gifford & Nilsson, 2014, p. 146). While being cautious not to assume that older people do not care about the environment, Gifford & Nilsson's (2014) research suggests that environmental concern lessens as people grow older, while their pro-environmental behaviour increases. The reasons for this shift can be many (i.e., the impacts of eras and global events), but age does appear to be an important influencing factor (Gifford & Nilsson, 2014), and fits in very well as a barrier in the awareness-action gap theoretical framework.

The tertiary precinct's low average demographic age was noted as a contributing factor to barriers for food waste management. This link between young people and food waste was also noted in the previous chapter (see Chapter 5 – Barriers to food waste minimisation). Although the data collected for this research was not sufficiently detailed to confirm it with huge certainty, it nevertheless shows an association between the two factors that is strong enough to discuss previous findings on the young age - food waste link.

When asked in a 2015 survey to rank their level of concern about their households' impact on the environment, the youngest age group of the survey sample , 18 – 24 year-olds, appeared 'the least concerned overall' (Tucker & Farrelly, 2016a, p. 692). This was a survey done as part of Tucker & Farrelly's research on household food waste. In 2018, a WasteMINZ report was able to build on those results; the report stated that 'age has the greatest influence on the food wasted within households' (WasteMINZ, 2018, p. 31). In this report, households with young people (16 – 24-year-olds) was profiled as high food wasters. 66% of respondents admitted to not making a conscious effort to minimise waste in their everyday life. When compared with other age groups, this group was found to be less likely to practice storage behaviours that may prolong food shelf life, and to be more likely to throw out the resultant leftovers. What motivates them most to minimise food waste was found to be the possibility of saving money. When presented with a list of eighteen different sustainability-related behaviours and activities (such as composting,

avoiding bottled water, or donating unwanted clothing), 55% of high wasters indicated that they always do 1 – 5 of them, and 31% indicated that they never do any of them (WasteMINZ, 2018).

Yet, the lines between young households and large households are blurred. A 2014 WasteMINZ National Food Waste Prevention Study report suggested that 'the number of occupants in a household has more effect on waste generation than the age of the inhabitants' (WasteMINZ, 2014, p. 34). Furthermore, a 2018 WasteMINZ campaign evaluation report confirmed larger households (4+ members) as high food wasters. Respondents from this group also appear to make less of a conscious effort to reduce waste in their everyday lives.

What we can take from these studies is that, in New Zealand, large households and households with young people are high food wasters; the 2018 report firmly establishes the link between both factors and domestic food waste. However, how these groups engage with food waste management alternatives is an area of study that remains largely unexplored. We already know that many households in the tertiary precinct are large households AND that the median age is low. We can with certainty claim that both factors present a barrier to sustainable food waste behaviours in the area. To what extent the combination of these two factors (low age, large household) affect food waste management behaviours in the tertiary precinct, and how this relates back to the awareness-action gap, is not possible to conclude without further, detailed data.

Interviews also showed associations being drawn between young people's need to stamp their own independence through rebellion, the local littering culture, and the effect that the littered precinct environment has on residents' inclination to engage in sustainable food waste management practices. Literature on such an association between littering and food waste is minimal. However, Secondi et al., (2015) found that a perception of living in a clean area is associated with virtuous residential behaviour (Principato, 2018); the 'perception of living in an area with little or no litter in the street is positively related with the production of small percentages of food waste' (Secondi et al., 2015, p. 34). This finding was based on an analysis of household food waste behaviour in European countries. If similar findings could be reproduced in a New Zealand setting, this interesting situational factor could potentially be used to justify local government policy

initiatives aimed at reducing rates of littering and vandalization. Secondi et al. (2015) suggest that local authorities could invest more on the side of street cleaning and maintenance for this purpose. Whether those types of measures would result in a long-term reduction of domestic food waste in the long term, or whether they would simply be addressing the symptoms of underlying socio-cultural trends, is up for further debate.

6.1.3.2 Population transience

As we have learned from this study, the transient nature of the tertiary precinct population is a real barrier when it comes to forming sustainable food waste management habits and routines. From a scheduling point of view this makes complete sense; handover of any local knowledge and on-site routines or systems from one set of tenants to the next may be completely severed if one cohort leaves in November (at the end of the academic year) and another cohort arrives in February (at the start of a new one).

Looking at this situation at a deeper level, could it be that the high frequency turnover prevents some residents from forming a place attachment? Place attachment is a 'cognitive-emotional bond that individuals develop towards places' (Gifford, 2014, p. 274) that are important to them on different levels. One of the key behavioural outcomes of place attachment is stewardship behaviours such as maintaining their residence and removing nearby litter. Research also shows that people with stronger place attachments tend to exhibit more pro-environmental behaviours (Gifford, 2014). For place attachment to be formed in individuals, time is usually the most influential factor; the longer a person interacts with a place, the more chance there is for positive memories, associations, and connections to that place to be accumulated and referred to. Long-term residents are more likely to form a deeper sense of place (a 'personal sense of place') than shorter-term residents are, and they typically also experience greater community involvement (Gifford, 2014).

Another reason to suspect a lack of place attachment among the precinct population is the lack of natural spaces in the area. As explained in the Dunedin Context and Relative Policies chapter (Chapter 4), the tertiary precinct is flanked by the Dunedin Botanical gardens. Despite their proximity to each other, however, the two areas are distinctly

severed from each other by fencing and the River Leith. The flavour of the tertiary precinct is plainly urban, with high rates of traffic and hard surfaces, and few green spaces. Could it be that the absence of nature in the precinct's urban environment is hindering residents to form a personal connection with it? Evidence shows that 'one key factor for strong connection to a local physical environment is interaction with nature, either through the creation and maintenance of a garden or access to a natural area' (Gifford, 2014, p. 281).

The theory of place attachment (or, as may be the case here, the lack of it) could be seen as another plausible barrier to pro-environmental behaviour within the area's complex socio-cultural tapestry. As shown above, littered environments have been linked to rates of household food waste and residents' willingness to engage in sustainable food waste practices. If a lack of place attachment could be shown to be a contributing factor to the high littering rates in the area, it would take a short mental leap to see the precinct population's transiency as another barrier in the awareness-action theoretical framework. Frantzeskaki et al. (2018) contend that urban living labs can facilitate transitions to sustainability in urban settings through collaboration and co-design with multiple actors (Frantzeskaki et al., 2018). As outlined in the Dunedin Context and Related Polices chapter (Chapter 4), UO is planning to launch their sustainability neighbourhood in 2021. Results from that 'living lab' experiment may be very valuable for future policy makers.

The above discussion shows an interesting link between the built environment, place attachment and pro-environmental behaviour. As this research is showing, the barriers to sustainable food waste management practices in the tertiary precinct are present at multiple and overlapping levels, sometimes blurring the lines between cause and effect.

6.2 The Built environment

This section will address **Research Question 2B**, which is: '**Does the built environment influence residents of the tertiary precinct's ability to manage their domestic food waste sustainably?**

Interview and survey results from this study confirm that the built environment has a profound effect on tertiary precinct household's current ability and willingness to process food waste on-site due to space restrictions, high rates of concreted surfaces, and factors that contribute to a littered environment. Space restrictions may even potentially affect the ability of some households to take advantage of any future kerbside collection services.

6.2.1 Survey results

Figure 6.2 below shows results for **Question 7** (*Does the house or flat you live in contain some outdoor, ground-level space, such as a back yard?*). All forty participants responded to this question; 70% of respondents (twenty-eight people) answered 'yes', 30% (twelve people) answered 'no'. This result supports the statement above that the built environment may indeed influence households' ability or inclination to process their domestic food waste through at-home methods such as composting, but that it is by no means the only barrier to sustainable food waste management for households in the tertiary precinct.

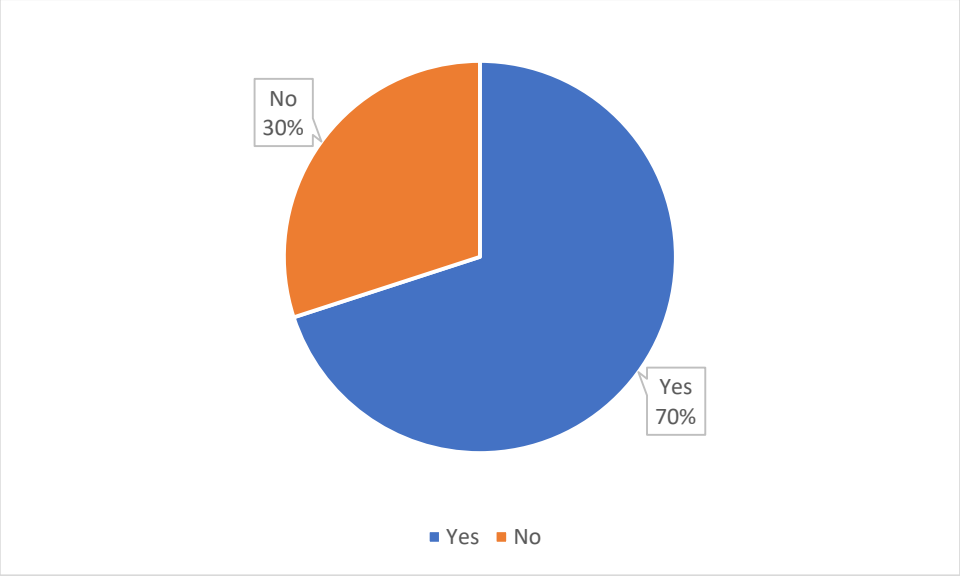

Figure 6.2: Proportion of respondents whose households include some outdoor, ground level space.

Figure 6.3 below reflects responses to survey **Question 11** (*What kind of methods does your household use in order to prevent throwing food waste in the weekly rubbish*

collection bin/bag, if any [e.g., worm farming, composting, feeding animals]?), twenty-six out of thirty-six respondents (72.2%) stated that their households do not employ any methods to divert their food waste from the weekly rubbish bin or bag.

> *None, food waste goes in the weekly bin. We don't have any other option (Respondent #36).*

Five respondents (13.9%) said they feed some scraps to animals, and another five respondents compost their food scraps. Only one household (2.28%) uses bokashi composting. One household has started placing food scraps in a 'scrap pot' outside, but there was no explanation as to what will finally happen to those scraps.

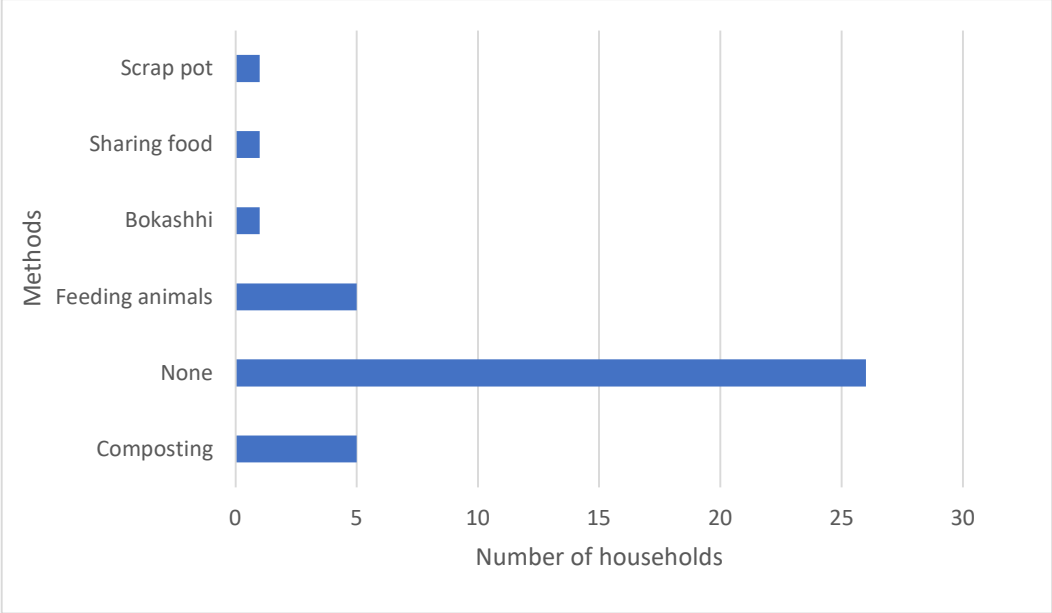

Figure 6.3: Methods used by households to divert food waste from landfill.

As already mentioned in Section 6.1.1 above, **Question 12** asked survey participants to reveal what hinders them from keeping food waste out of their households' weekly rubbish bag. Results to this question, previously depicted in Figure 6.1 above, is reproduced in Figure 6.4 below for convenience to the reader.

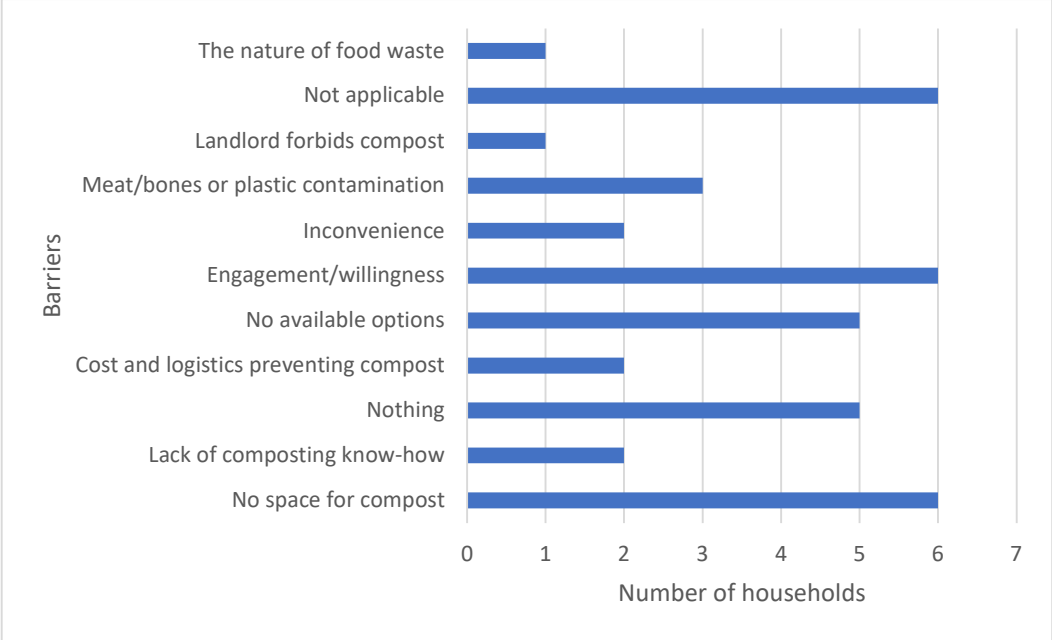

Figure 6.4: Barriers to sustainable food waste management.

Sixteen out of the 39 participants (41%) who responded to Question 12 did not have the option to compost, either because there is no space available for that activity (15,4%), because they do not know how (5.13%), the cost and logistics of setting up a compost (5.13%) or even because their landlord forbids it (2.6%). Five respondents (12.8%) gave less specified reasons for why the option was not available, and simply stated that they did not have any alternatives for managing their food waste other than the weekly general waste bin. The nature of food waste itself, i.e., its potential to emit a foul smell, was mentioned as a barrier only once (2.6%). Three respondents (7.7%) named bones and non-compostable materials such as plastic in teabags as barriers to managing food waste at home. Two respondents (5.13%) indicated that Question 12 did not apply to them since they do not produce food waste, and five people (12.8%) did not experience any barriers. Six respondents (15.4%) gave various unapplicable answers that did not add value to the results for this question.

> *Literally nothing in any of the flats I've lived in in the past four years has made it easier to prevent food waste. None of the flats had any grass in the outdoor areas. Flatmates are variably uninterested in sustainability, which also makes it more difficult (Respondent #36).*

6.2.2 Interview results

6.2.2.1 Space and concrete

Successful food waste management methods such as back-yard composting, bokashi composting and worm farming requires appropriate knowledge, commitment, and resources – both spatial (appropriate space and situation is required), temporal (being the conduits for biological processes, these methods require management and care), and material (certain equipment is required, such as appropriate containers). Most interview participants indicated that many residents of the precinct lack one or all of those attributes. Interview results confirmed that a significant proportion of residents would like to process their food waste sustainably but are prevented from doing so due to their living situation.

One barrier that was mentioned frequently was the fine-grained characteristic of the built environment of the precinct, and its high proportion of impervious surfaces. The lack of green space, through small yard sizes and concreted surfaces, transpired as particularly prominent barriers in this regard. Bokashi composting can be done indoors, but even this option requires sufficient indoor storage space, correct management, equipment, and know-how, constituting a potential barrier to it even being considered.

> *You've got students down in the tertiary precinct area that are very environmentally conscious, and they want to be composting. But they may be in a house where the backyard is concrete. So, they don't have the space to be enabled to compost. Probably the only opportunity they would have to compost would be bokashi composting and you really do need somebody who's going to champion that to work, and then that has to go somewhere. So, there are some challenges around that option (Local government official #1).*

Many households that manage to process their own food waste sustainably despite these spatial issues still need to contend with them when it comes to finding a destination for the end product, especially if there is no garden space available. Several key informants pointed out that it's all very well for households to process their food waste in a bokashi bin or worm farm, but they still need somewhere meaningful to put the worm castings or compost at the end of the biological process.

> *Students don't have time to be creating compost and using compost because you can't just create compost. [W]hat's the point in just creating mountains and mountains of it in your back garden when you don't use it? You need to put it somewhere (Sustainability expert #1).*

Even when space is available for outdoor composting, a lack of resources still remained as a perceived barrier to taking it up. Some equipment is required (composting bin, garden fork, buckets, etc) for composting activity to take place. Four key informants confirmed that, from their experience, a good proportion of the student population is extremely averse to spending money on any kind of waste management due to their tight personal budgets – see section 6.3.2.2 *General waste issues* below for elaboration on this point.

Composting aside, the density of the built environment in the tertiary precinct also has the potential to impact households' ability to take part in proposed future changes to Dunedin's kerbside waste collection service. Option 2 of the DCC's proposed kerbside collection changes would involve issuing one new red-lidded bin (for general waste) and one new green-lidded bin (for organic waste) to each household in Dunedin, for separating household waste and to be placed out at the kerbside for collection on the allocated day of the week. These bins would be in addition to the existing, yellow-lidded bins (for mixed recyclables) and blue bins (for glass recycling). Four key informants acknowledged that some households in densely built areas may not have sufficient room outdoors or indoors for these new bins and that many households already have to store their bins on the kerbside permanently due to lack of space. There are options in the

system for households to ‘opt out’ of a collection service, but they would still get charged for it through their rates and opting out would mean that recyclable materials would go to landfill if placed in the general waste bin. This is an issue that has already been identified by DCC staff, and which is being investigated as part of the feasibility work being undertaken.

Furthermore, one key informant pointed out that bin collection in a densely built environment can be hazardous and get in the way of pedestrian traffic. Pedestrian traffic in the tertiary precinct is very high, and of a particular nature:

> *Obviously, a high proportion are students who live in the precinct. … about 90% of people are in some sort of education and about 90% walk or jog to their place of education. You also tend to get students walking in groups and you also get waves of students in time with the beginning and ending of lectures. So that sort of combination of things means that there needs to be more space for them but that could also mean space for things like facilities for food waste and recycling (Local government official #3).*

Also in relation to the space-waste conundrum, there was evident frustration among two key informants that consideration for practical functions such as waste are often left to last in the design of buildings and urban spaces, sometimes not being considered at all:

> *People forget to plan a kitchen for waste recovery, because we don't have just one bin anymore. And yet we still act like we do. And I find that is so archaic. And it's not just in the building of your house. It's in the building of your business property that you're working in, or it's in the building of a city. We don't create spaces that enables us to separate and collect. We built an entire city here in Dunedin with zero serviceability, there is no level of serviceability, we cannot get some of the trucks that we need to collect rubbish recycling, compost, you name it, all the different types. … And it's still*

at the bottom of any planner, any building designer any house designer, architects. It's at the bottom of their list. They don't even get to it. They don't even think about it - it drops off their list. And that really bugs me (Sustainability expert #1).

Illustrating this point, observations were made on a local trend for new housing developments failing to incorporate appropriate space considerations for the storage of waste at the design phase despite this being a requirement of the New Zealand building code (*Compliance Document for New Zealand Building Code Clause G15 Solid Waste*, n.d.). However, there was reluctance to making any comments on whether a lack of adherence to that requirement illustrates a lack of diligence during the council's assessments of building consent applications.

6.2.2.2 Behaviour change versus changes to the physical environment

During conversations with interview participants, it become clear to the researcher that there is a split in opinions on whether there is any point in improving the built environment in relation to food waste before behaviour change in the area is evident.

One group of informants, pointing to the section of the precinct population that, for whatever reasons, do not understand or care about the need for sustainable waste management, stressed that behaviour change in the area should be prioritised before physical improvements would have any effects and that the issue needs to be tackled on many cultural and social levels first, not just from a spatial or civic planning perspective. This group indicated that behaviour change campaigns aiming to normalise sustainable waste behaviour in incremental stages (such as those done by Love Food Hate Waste) would deliver the most positive results.

I think we can make the greatest Town Planning design we could possibly come up with but unless it's also got engagement from many, many different levels, then I'm not sure a design will ever work. It needs to be the movement' (Tertiary education staff #1).

I think that specific to food waste, it's all eyes on the council at the moment to see if we can get some trials or some pilots and what can be achieved by some sort of kerbside organic waste collection. We know what works elsewhere in the world. We know, there'll be a whole lot of behaviour change and education required to make it workable here. Much more careful sorting behaviour. Yeah, because already our sorting behaviour in New Zealand is very low quality. So, if we start moving to organic waste collection, that quality becomes much, much more critical. So, we know there's going to be challenges there. But looking to the council because it's at a municipal level that the solution needs to come (Tertiary education staff #2).

I guess it's easy for a council to build something but it's really hard to get people to change their behaviour cause that is something that almost comes from something that is like social circles and … I think that it's probably education and behaviour change (Local government official #2).

A second group of informants pointed out that one of the barriers to sustainable food waste management that some residents encounter is the lack of an enabling structural environment and infrastructure, rather than their own or others' values. This group felt sure that a municipal food waste collection service would have high rate of uptake in the area and may in fact spur behaviour change of its own through the conscious act that consumers will have to make when separating their organics from other waste.

Occasionally, probably once every six months, I'll get an email from a student saying they'd like to compost and can they bring their food waste into campus. So there are students that are willing to make a particular effort to do it. I think sometimes that some of the international students, particularly from the States, they come and they

find it quite bizarre that it's not a lot more commonplace. They're used to doing it and yeah, and they want to carry on while they're here (Food waste researcher #1).

I think the easier you can make it for people to do the right thing, the better. If we have more of these community hubs, for those that don't have an easy way in which they can compost for example on their own sections, a way that they can easily get it to a hub, that's one way, I guess. If there is a collection facility, making that easy and regular, or on-call, if that's a possibility. Things of that nature, I guess. But making sure that there are no barriers for that collection in the built environment. So just really basic things, like there's enough room on the footpath so that you can put bins out which aren't going to get in the way of pedestrians and whatever. […] It's part of that more broad idea of having a sense of pride in where you live, and trying to get rid of that stereotype of the precinct as a bit of a trashy area (Local government official #3).

6.2.2.3 Signalling

As outlined above, there was agreement among all interview participants that the high levels of littering and low amenity values in the area have negative signalling effects on waste behaviours - normalising littering behaviour and thereby fulfilling the narrative of Dunedin's reputation in a type of vicious circle. Praise was given for the type of signalling delivered at the OP campus with fully visible composting patch, permaculture gardens and signage that invite people to pick food from it.

Suggestions were made that provision of more communal and green spaces in the area may help residents to nurture more of a community spirit and thereby more willingness to engage in sustainable behaviours. Several informants saw potential in the recycling hub concept being expanded and enhanced to incorporate seating, planter boxes and even barbeques, signalling to residents that the space is for them to use and socialise in. It was also suggested that introduction of green infrastructure such as rain gardens in the

streetscape of the tertiary precinct, an option that will be considered as part of the safety and amenity upgrade, would serve as good signalling in terms of level of care in the area and softening the streetscape. Information on the tertiary precinct street upgrade project is provided in Section 4.2.1.6 above.

> *One thing [the DCC] will be looking at is opportunities to include green infrastructure, things like rain gardens which are one way of trying to enhance the environment by better managing storm water in a way which treats it as well as attenuating flood flows and taking some pressure off the pipe system. I suppose that is one way in which we can work as – almost as a kaitiaki values of looking after the environment. And that can have a broad scope beyond storm water. Those rain gardens will also enhance the urban ecology and amenity and speaks more broadly to the whole looking after that part of the urban fabric of Dunedin. … It's a Fingers crossed situation cause there's a lot of that land is reclaimed land and they're going to do a bunch of investigations to see whether it's feasible and where the water table is in that part of Dunedin (Local government staff #3).*

The current level of service and future space requirements for waste and recycling facilities and collection will be taken into consideration during the design stage of the tertiary street amenity and safety upgrade project. At this point the project is still in its early stages and finer details such as waste provisions have not yet been decided on.

6.2.3 Discussion

Food waste is an organic product, the state of which is never static; biological processes are required for this product to fulfill its potential as a resource. If the built environment is not conducive to those processes, then food waste must be moved to a place that is.

The results presented above strongly indicate that the built environment in the tertiary precinct forms various barriers to sustainable domestic food waste management. The fine-grained urban landscape with high rates of concreted surfaces leaves little or no

room for backyard composting and future additional bins for organic waste. High occupancy rates can also lead to indoor storage issues, which may restrict households' willingness to take up bokashi composting. In addition, as shown above, high rates of litter in the streetscape may inhibit residents' inclination to engage in pro-environmental activities in the first place. Although it could be argued that litter could not be described as the built environment, rates of littering can both be caused (in part) by the composition of the built environment, and it can influence the perceptions and behaviours of residents of a neighbourhood.

Academic studies on how the built environment influences sustainable food waste practices are difficult to find in the literature. Burke and Napawan (2020), however, highlight that environmental and urban design can play a pivotal role in this context if their approach to urbanism is allowed to move beyond the utilitarianism of physical sites, and engage with it in a more dynamic and holistic way (Burke & Napawan, 2020). They observe that while places where food is eaten, prepared, grown or sold are conspicuous within the built environment, 'places of food waste are less often celebrated and are only marginally, if at all, considered a design project' (Burke & Napawan, 2020, p. 169). They further argue that by allowing food waste to be relegated to a place of obscurity within the built environment, planners and designers 'passively support cultural attitudes that counteract sustainability and fail to adequately evaluate human impact on the environment' (Burke & Napawan, 2020, p. 170).

It could be argued that the difficulty in finding appropriate space and places to store or process domestic food waste in the tertiary precinct is an illustration of this sentiment. The high rate of concreted surfaces in the precinct, a result that appeared regularly throughout this research as a barrier to home composting, has not come about by accident; as shown in the precinct development plan, the paving over of front gardens had historically been done in order to meet residential parking requirements in the Dunedin City District Plan. Planners subsequently acknowledged that a loss of amenity had occurred as a result of this practice and a District Plan variation was made in 2003 (Variation 12: 7/5/03) to applicable provisions to 'ensure they are effective in maintaining amenity in the Residential 3 zone in North Dunedin' (Dunedin City Tertiary

Precinct Development Plan, 2008, p. 8.4). These planning events show an importance afforded to both parking and amenity in the area but no mention of waste.

This silence around the dynamics between the built environment and food waste can also be detected in the 2nd Generation District Plan (the 2GP) and the higher-level urban development planning document National Policy Statement for Urban Development 2020 (NPS-UD). Parking requirements for residential zones in Dunedin were reduced a little in the rules of the 2GP (2GP 15.5.8), and, with the introduction of the (NPS-UD), they are now required to be completely removed (except for accessible car parks) in Policy 11 and Subpart 8 – 3.38(1) (NPS-UD, 2020). The removal of residential car parking can lead to positive effects, such as increasing the development and density potential of certain building projects or land parcels, increasing amenity, and encouraging increased uptake of public transport. As such, NPS-UD Policy 11 and NPS-UD Subpart 8 – 3.38(1) help to fulfil NPS-UD objectives 2, 4, and 8 which aim at improving housing affordability, amenity, and reductions in greenhouse gas emissions (NPS-UD, 2020). The NPS-UD is a response to New Zealand's ongoing housing crisis (Ministry for the Environment, 2020a) and its main thrust is to unlock development potential and improve housing affordability in New Zealand's rapidly growing urban centres. The importance of amenity and greenhouse gas emissions is also reflected in its policies and as we have seen, car parking has been afforded an entire policy on its own. Despite the large greenhouse gas potential of food waste, however, there is no mention in the NPS-UD of how considerations of food waste issues and solutions could be incorporated into the design of our booming cities. Perhaps the NPS-UD is too much of a high-level document to be considering such things as food waste. Conversely, perhaps the NPS-UD is another example of a missed opportunity for bringing food waste out of the shadows of afterthought and into people's consciousness.

Interpretations of aesthetics and visible structures 'often dominate discourses of urbanism' (Burke & Napawan, 2020, p. 186). In Dunedin's tertiary precinct, an opportunity is on the horizon to bring a deeper dimension to that narrative by incorporating visible reminders of the city's metabolism through urban and environmental design. As outlined in the Dunedin Context and Related Policies chapter (Chapter 4), upgrade work is required to be done in selected streets in the tertiary precinct

and a streetscape amenity and safety project will be carried out in those streets once the underground work has been completed. This project will be done in partnership between Dunedin City Council, OU, and OP. Through environmental design and strategic timing, there is scope within this project to incorporate a focus on the profound importance of food and food waste. For example, opportunistic design that simultaneously incorporates green space, recreation space and waste disposal space could be utilised as part of a multi-pronged approach in the precinct to improve amenity, help raise awareness of the impacts of food waste, reduce littering and even help induce a sense of place and place attachment.

We can look to other cities for examples of how collaboration and environmental design can help communities to become more aware of the connections between the health of the environment and their own domestic practices. To address the impact that the improper disposal of fats, oils, and greases (FOG waste, also known as fat bergs) through residential kitchen sinks was having on their sewer system, the City of San José decided in 2013 to invest in its community rather than simply installing larger sewer pipes or technological innovations. The city arranged a number of participatory community workshops where concerns of the local community were heard, and ideas and knowledge were exchanged. The city's designers also gathered infrastructure information through site visits and regular meeting with maintenance workers. The result was a design project that included informational graphics and a digital social media image network that documented how hidden sewer infrastructure and environmental concerns were directly connected to domestic cooking practices, incorporating the 'interrelated concerns of individuals and the larger community of both human and noon-human nature' (Burke & Napawan, 2020, p. 183; *#fogwaste - Twitter Search / Twitter*, n.d.)

Many points of interrelatedness emerged through San José's FOG waste project, most notably how sewer backups and overflows, caused by FOG waste, can negatively impact the environmental health of San Francisco Bay – a waterway where many community members go fishing. Thus, through this participatory process, which made people's concerns heard and also made people more aware of the invisible infrastructure, a direct connection could be made by community members between their own kitchen sink and how what they pour down it can impact their own food supply.

As noted by Burke and Napawan (2020), 'there is a need for environmental design that draws connections between public and private spaces, between natural and built environments, and between consuming and disposing of food.' (Burke & Napawan, 2020, p. 178). The tertiary precinct is an ideal candidate for multi-dimensional improvements. With awareness of food waste and its importance rapidly growing at international, national and local levels and with a street improvement programme poised for design commencement, the current timing is impeccable for food waste and all that it entails to be given the attention it deserves.

6.3 Lack of infrastructure, support and services

This section will address **Research Question 2A**, which is: '**What are the barriers to sustainable food waste management practices among households in Dunedin's tertiary precinct?'**

As shown in the previous chapter (Chapter 5), many residents in the tertiary precinct do what they can to minimise their food waste. However, results also show that many residents and households in the area find it difficult to engage in sustainable domestic food waste practices on several levels. Some barriers that surfaced were related to the lack of infrastructure and services. A lack of enablement and support to engage in sustainable waste management were also read as barriers, albeit less tangible.

6.3.1 Survey results

Survey results strongly suggest that a lack of a council-run kerbside food waste collection service is a major barrier to sustainable domestic food waste management practices in the tertiary precinct.

When asked (in **Question 16**) whether they would use a community composting facility for their household food waste, thirty-three out of thirty-five respondents (94.3%) answered 'yes'. However, when asked which option they preferred between a community composting facility and a council-run food waste kerbside collection service, the latter option was clearly favoured with a 94.3% hit rate (see Figure 6.5).

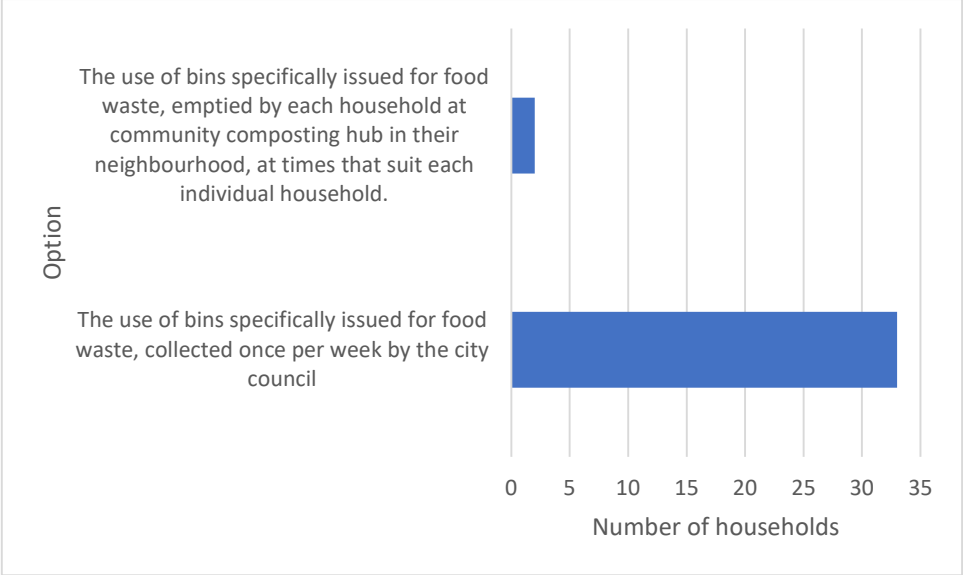

Figure 6.5: Preferences indicated for food waste management service.

This preference for a council-run service was reinforced when respondents were asked (in Question18) to provide suggestions for ways in which the council could address food waste, specifically in the tertiary precinct. As shown in Figure 6.6, 47% of respondents suggested the council incorporate food waste to their kerbside collection system.

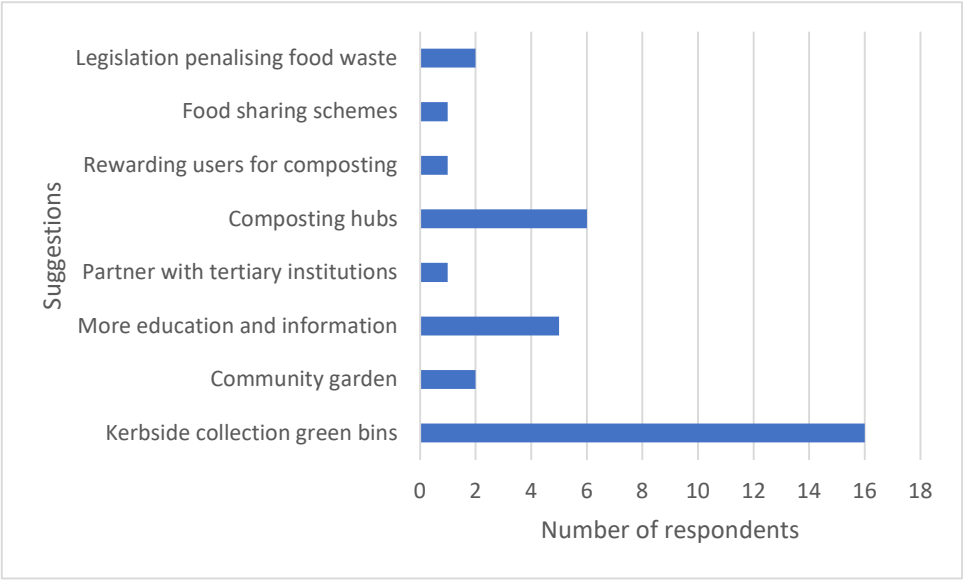

Figure 6.6: Types of suggestions for Council on addressing food waste issues.

> *I think [f]ood waste collection bins that go with the other bins collected by the council would be the easiest as composting is too hard in a student flat when you know you're*

going to be moving next year so don't want to put money and energy into setting it up at a flat (Respondent #4).

These survey results strongly indicate that a food waste management service is desired by households in the tertiary precinct, and that the introduction of such a service would have a high uptake rate. Further data collection may be required to confirm this, considering the small sample size of the survey.

6.3.2 Interview results

6.3.2.1 A lack of Infrastructure and services related to food waste

In an increasing number of cities around the world, local governments and institutions are putting in place infrastructure for diverting food waste from landfill. As such infrastructure is not yet in place in Dunedin, private residents who wish to divert food waste from landfill are left to manage their domestic food waste via alternative methods. One type of infrastructure that could make diversion simple and easy for private households would be a council-run service for kerbside collection of organic waste. As explained in the Dunedin Context and Related Policies chapter (Chapter 4), the DCC is currently planning for improvements to their kerbside waste collection service but whether that upgrade will incorporate food waste has not yet been revealed. As of 2020, a council-run food waste collection service for domestic households is not yet available in Dunedin. Interview results show agreement across all informants that the lack of a municipal kerbside collection service for food waste is as an obvious barrier to sustainable food waste management in the precinct.

All interview participants recognised that public infrastructure in Dunedin for managing domestic food waste is almost non-existent, but there was disagreement on the type of infrastructure that would be most beneficial for the city. Although options at the collection-end are being considered by the DCC, viable options for the type(s) or processing models at the back end that may be considered have not yet been publicly

released. Early public engagement on changes to Dunedin's kerbside waste collection service was conducted in April 2020. No key informants were able to give an indication of when survey results from that online survey, although it is understood that 'thousands of responses' were received. Formal engagement on changes to kerbside system will be incorporated into 10-year plan processes in 2021. A heightened level of anticipation and strong opinions permeated in some interviews as to the type of model the council will go for if or when organic waste kerbside collection goes ahead in Dunedin in the coming months and years.

Two informants saw this lack of infrastructure as a barrier to future sustainable food waste management in Dunedin, and envisioned that an efficient and industrial-scale processing model would work best for the city, also reflecting on the importance of considering viable markets for the end product:

> *I would love us to have a city scale composting facility a bit like Living Earth in Christchurch. They take green waste and food waste in their bins which is quite good cause it diverts the organic waste. But the difficulty about that is that it can be harder to sell the material because you have less control over what materials are going into the compost. That determines the quality of the compost at the end and therefore it determines who you can sell it to and what for (Local government official #2).*

A third person saw Dunedin's current lack of infrastructure as an opportunity for the city to break new ground and lead the way in the field of food waste management. This informant suggested the council embraces a decentralised model for the management of the city's food waste and look to transition design frameworks, permaculture design or other holistic planning methodologies to find wholistic and effective practice principles:

> *They've kind of already put out a proposal on what the collection will look like but there is no plan of what the processing back-end will look like. That I think is really*

exciting and a chance for us to do something really interesting. But we need to make those options loud and clear to the DCC and the general population as well, that there is not just one answer to it …

The kind of model I have in mind is a distributed, decentralised collection and processing model that we might have centred at schools or community gardens or other community spaces - they could be local processing and management hubs for those collected materials from their neighbourhoods or suburbs so that we have a series of smaller processing hubs so that the material never has to go far to go there or to come back as finished compost or fertiliser, and that will allow people to engage with their local area, see the impact on the local ecology, whether that goes to the school garden or if people can pick up a bag of compost and take it home. Some way of making it so that that 'other', 'somewhere else', 'over there' out of sight clearly doesn't exist, would be really useful. I think that is one that gives a greater investment of the system on the whole. It probably allows it to be upheld and be more resilient, but also help avoid challenges I've seen happening in massive centralised composting systems like the one they have in Christchurch. They have a huge processing facility, it's massive and industrial and just way beyond the comprehension and engagement of most people. It's way out of the city – you don't know where it goes, so it's just another bin that you put out in the street and it goes away. (Tertiary education staff #1).

One key informant underscored that, whichever model is chosen for food wase management infrastructure in the future, small-scale trials should be run before the model is rolled out city wide. Three informants thought the tertiary precinct could be a suitable place for such a trial. Another informant warned that the demographic makeup of the tertiary precinct is different from most Dunedin suburbs, and that pilot results from the tertiary precinct would therefore not necessarily be an indication of how things would work in other residential areas.

Five informants stated that better baseline data and more accurate and nuanced data from waste audits is needed for any waste strategy in Dunedin to be truly meaningful. Two

people were critical of the standard of current auditing practices for the city and thought better auditing of waste in general and a bigger sampling size would be the first place to start for improving the measure of Dunedin's household waste data.

> *You need to look at how many bags they actually do [audit]. And I think they do something like 90 or 200 bags. And that is not enough bags for a city (Sustainability expert #1).*

One informant recommended that both local and national governments adopt the UN SDG 12.3 targets and commit to reporting against those targets. To make the data useful and relatable to residents of specific precincts or suburbs, council should not just report captured data in terms of innate weight quantities (such as kg/household) but translate it into things that make sense to the demographic of each area. In terms of the tertiary precinct, that data could then with confidence be used in education material. For example, how much money a typical student household could save by reducing their food waste over a 10-month period. It was suggested to also tie educational and outreach material in with the bigger national and international social movement of global food waste reduction.

Out of the ten key informants interviewed, four key informants were very well informed on the WMMP2020. Most had no comments to offer although one person suggested that the aspirational targets in the WMMP2020 appeared to be based on blue sky thinking rather than calculations.

Although five key informants were informed on the existence of the green waste and composting rules in the Otago Waste Plan, there also appeared to be some confusion around exactly what the rules meant. One of those people believed that the policy is poorly written, lacking in clearly defined standards and definitions. No key informants offered any food waste-related opinions on the 2GP.

Within the food waste disposal service vacuum, an opportunity exists for its two large tertiary education institutions, UO and OP, to provide private residents in the tertiary precinct with options to divert their domestic food waste from landfill. However, the potential of this opportunity is not currently being fulfilled; interviews revealed that both institutions are working on systems for on-site food waste processing, but very few domestic residents will be able to benefit from those systems – at least for now. Key informant interviews revealed that plans are in development between UO's Property Services and an external contractor for the diversion of food waste from landfill through technical innovations that will enable on-site processing of the institution's food waste (including waste from residential colleges). However, it was also confirmed that the University will not be making this facility available to private households. The situation is much more promising at OP, where a new composting facility is being developed. Key informant interviews revealed that the facility is still at an early stage with the design of prototypes being trialled for processing food waste from both the institution's kitchens and its new hall of residence. The system is being designed both for its obvious function of processing institutional food waste in a sustainable manner, but it is also being designed with educational value in mind: the intention is to incorporate it as a teaching platform in the future (Boyle et al., 2018). Although still under development, the service is already functioning and is open to local residents to use for their domestic food waste. However, as one key informant revealed, due to limited resources allocated to the promotion of that service, word has not reached a large audience and consequently the service has had a very low uptake among the local resident population. It is feasible that this low uptake can also be linked to limited appreciation of the serious environmental effects that food waste can cause (as discussed in Section 5.3.3).

With limited food waste disposal infrastructure and services, the remaining alternatives for tertiary precinct residents to divert their food waste from landfill would be private sector organic waste collection, worm farming, bokashi composting, backyard composting and feeding animals. There was close overlap between the lack of food waste separation facilitation and already existing waste issues in the tertiary precinct.

6.3.2.2 General waste issues/Existing waste behaviour in the precinct

Any resident of the precinct that is not able or willing, for whatever reason, to engage in the sustainable food waste processes mentioned above, is left with the choice of disposing of their food waste either via the city council's kerbside collection for general waste, via private sector refuse collection services, or via periodical university-funded 'skip days'. Anything disposed of via council refuse bags or the university-funded skips ends up in landfill.

Private sector operators in Dunedin offer green waste/garden waste collection services, but food waste collection is only marketed as a service available to businesses, not private households (Envirowaste, 2020; Waste Management Ltd, 2020). No results indicated that private households in the tertiary precinct use this service for household food waste. To use the council service, specific council-issued black refuse bags must be used. These bags are available for purchase at $3.30 each (for one, 65-litre capacity bag) (Dunedin City Council, 2020a). The University-funded skips are available to precinct residents free of charge. All key informants confirmed a widespread practice whereby student households stock-pile household waste in low-cost refuse bags at their own premises, sometimes for several weeks, in order to take advantage of the free skips. Four key informants confirmed that the main reason for residents choosing to throw their rubbish out in the skips rather than via the weekly council service was purely based on cost.

The intention of the university-funded skips is for larger items and overflow waste that will not be picked up by normal kerbside collection services as a kind of pastoral service to student residents in the area (University of Otago, 2020). However, three key informants acknowledged that some households abuse the skip days by using it for their general household waste. Two key informants underscored how the university's skips, by allowing any rubbish to be discarded in them, may inadvertently lead to undesirable, indiscriminate waste behaviours.

> *They don't see any point in paying for kerbside… DCC bags. And so they just store the rubbish, including the food waste, in the backyard […]. And so again, good intentions*

in terms of trying to clean up the area may be having unintended consequences. And that is just purely driven by price, just because there's a free option and a paid option. And if you're a student, why would you pay if it's free (Food waste researcher #1)?

I don't think it's very helpful to actually shifting behaviours. I think it is good in terms of means that the trash is not on the street. But I don't think it actually helps change culture at all around awareness and engagement with materials and their value. And so, people are almost encouraged to throw things away without much consideration. I think it's a major thing (Tertiary staff member #1).

There was unanimous agreement that general waste and litter issues in the precinct can in part be traced back to the volume capacity of the current municipal kerbside recycling bins. As dwellings in the precinct often have a high occupancy rate, many residences produce higher-than-average volumes of recyclables, and recycling bins often overflow. In recognition of this capacity shortfall, the DCC has recently installed two recycling hubs in the precinct. Key informants applauded the DCC for installation of the hubs, recognising the hubs' potential to both improve littering rates as well as encouraging better overall waste separation behaviour of residents in the area. However, one key informant opined that not incorporating future food waste collection in the design of the recycling hubs has been a 'major oversight' (Tertiary education staff #1). Also, not all informants are convinced that the recycling hubs will be an overnight success, as the general standard of waste-sorting behaviour in the area is understood to be very low or non-existent in some households:

One flat of five lads with a ute at a trailer doing four trips with the trailer completely full of unsorted waste is one example … I think before we can start having an influence by the streetscape. I don't have data to support that that will happen, but we're going to have to watch the recycling hubs quite closely… [During the] Skip diversion day,

... a whole skip of cardboard was deemed as too polluted with either wet cardboard or food waste. And it all went to landfill ... But that's still waste in general. [E]ven if they're sorting those other waste streams, we still don't have a solution for them for food waste. It's kind of – it's the most difficult, dirty, smelly problem that people don't want to deal with. And it's right at the end of what we can do ... I've huge concerns about what will happen to the Castle street recycling centre, and that it will become a focus for dumping and fly tipping everything (Tertiary education staff #2).

No interviewees could confirm that the skip service will be phased out. However, in an effort to stamp out skip abuse, the University and OUSA have collaborated to initiate 'skip diversion', during which students are encouraged to separate the waste they bring to the skips, to allow for recycling of materials.

6.3.2.3 To compost or not to compost: vermin factory versus connecting the dots

If composting is done incorrectly, it can have unpleasant and unhealthy consequences, such as putrid organic materials and vermin infestations (Strauss, 2009). Three key informants highlighted a lack of composting/worm farming/bokashi know-how among residents in the tertiary precinct as a barrier to households in the area diverting their food waste from landfill. Three key informants indicated that some student flats in the area are hindered in carrying out those types of food waste management activities through lack of support and permission from landlords or letting agencies to do it. Most participants were of the impression that landlords and letting agencies are very indifferent to, and in some cases even work against, tenants' initiatives to lead sustainable lifestyles. One example was given where landlords do not permit on-site composting. In another reported instance, a letting agency had advised tenants to simply leave their waste in anonymous low-cost bags on the street for the council to remove. It was pointed out by three informants that more targeted education and collaboration outreach towards this quarter should go a long way to remove that barrier. The researcher was unable to secure an interview with a representation from this stakeholder group.

Interviews revealed split opinions on whether residents in the tertiary precinct should be encouraged to engage in backyard food waste management activities. Those against it meant that students should not be burdened with the task of managing their food waste at home, that their lifestyles and high-density living situations are not conducive to composting and that *ad hoc* composting piles in back yards will (due to lack of appropriate knowledge and care) simply attract vermin and emit foul smells, doing more harm than good. It was also pointed out by four key informants that many households would have no place to put their compost if they did manage to produce it, due to a low rate of gardening practice and garden space in the precinct. This group of key informants were advocates of food waste being managed through municipal kerbside collection only.

> *We've got households which are just absolutely rammed together with no growing space, no garden space and nowhere to put a little compost bin. And when you've got the amount of people that generate the amount of waste that might come out of a student flat, you know what to do with it, and how do you manage it? And how do you stop it from just attracting rats and causing problems? I don't think managing it on-site for each household is the answer. I think it needs to be taken away (Sustainability expert #1).*

Two people in this group pointed out that by separating food waste from their general waste, residents would need to engage with it and think about it – and that this action alone could have positive flow-on effects on food-based values, even if the residents would not be involved in the remainder of the process that would transform that food item's 'journey'.

The second group of key informants meant that further encouragement of households' engagement in food waste management would be beneficial. While recognising the benefits of municipal food waste collection in the quest for landfill diversion, this group also incorporated value-based views by questioning the benefits of removing all such organic material to a remote processing facility. It was pointed out that processes that increased engagement with, and visibility of, organic waste and compost, may have the

added benefit of increasing residents' awareness and appreciation of the material, and 'connecting the dots' on how to 'close the loop' in a circular economy.

> *And the thing is, we don't want to displace the person who home composts. It's really important because of behaviour change – that's where the behaviour change is. So, when you put something in a bin, you don't get the same connection. It's 'I've just discarded something again'. You know, even if it's going to a [remote] composting facility, it's still discarding. (Local government official #1).*

> *One of the issues I see with food waste management around the country – and, you know, it's especially true in a place that has almost zero engagement with food waste management – is [that] people don't … feel the impacts of really effective management of those materials. You know, if, when I put my little kitty of food waste or something for my flat out into the street and it gets collected, you know, something happens to it. If I could then see that compost being applied to the fruit tree that grows on the verge in front of my house, then I think I would have a much greater engagement and appreciation for the value of those processes and the positive impact ecologically, personally, and socially, you know, in our street as well. So, they're connecting the dots of what happens to those materials. And yeah, that you know, making it very clear that that concept of somewhere else that my waste goes, is a total misnomer and doesn't actually exist (Tertiary education staff member #1).*

Regardless of their stance, most key informants underscored that food waste management services need to be easy and convenient to use if widespread uptake and behaviour change is to be hoped for.

6.3.2.4 Community initiatives

Interview results revealed that there is notable interest among key informants for food waste-related community initiatives. However, a certain tension was detected between factions in the community regarding with whom the responsibility for domestic food waste issues lies.

Four key informants confirmed that they are regularly approached by locally residing students who wish to either manage their food waste at home or to make use of a local food waste collection or processing facility, and who are not able to carry out that wish due to the unavailability of facilities. Apart from OP's new and developing composting facility, there are no local community-based food waste processing available in the precinct. The student-led organisation SEA does run a campus garden, but this group is not focusing on domestic food waste. If SEA did decide in the future to invite local households to deposit their food waste at the campus garden, they could, depending on the stock volume, experience Rule 7.6.12(e) of the Otago Waste Plan as a barrier to their plans. As explained above in the Dunedin Context and Related Policies chapter (Chapter 4), the Otago Waste Plan requires that 'the composting is undertaken on the property from which the majority of the material is sourced'. This rule would apply to any composting site that receives amounts of food waste from surrounding sites that surpasses the amount of onsite garden material to be composted, requiring a resource consent application to be lodged. Two key informants indicated that this rule is a key issue for one additional community-based group, located nearby, that is currently operating in such a manner. Operating contrary to regional rules without having obtained a resource consent places both that organisation (which shall remain anonymous), and the owner of the land of which they are operating, at risk. According to one key informant, having to apply for a resource consent is 'often a barrier because groups don't want to go down the lane where it feels intimidating. It just becomes a bit more involved' (Local government official #2).

Most informants acknowledged the potential benefits that a decentralised or community composting model could deliver in the tertiary precinct. However, it was also highlighted that formal agreements and policies would need to be established for any such system to be lasting and successful; checks and balances such as where responsibilities and

accountabilities lie, what kind of funding models would work, and whether destination markets for the end product exist, would need to be carefully considered and agreed upon between both the local authorities and the operator of the facility.

> *Community leads versions are definitely a win because it can make people feel empowered and getting involved and brings people together as well. And it's more local scale, too. Keeps people connected to the material and ... yeah, it's definitely a winning thing. It's just a difficult thing to achieve ... The difficulty is, I guess, is who looks after it? If it's run by a community group. And then if the person who's leading that moves ... it can often fall apart and then you've got a massive food or compost kind of mess there (Local government official #2).*

The composting facility at OP is a good example of community-council collaboration delivering a sustainable food waste management solution. According to one key informant, it was very little trouble to navigate the appropriate planning rules to be able to initiate their composting plant.

Considering the fact that UO is currently developing plans for local food waste processing systems in the future, one could argue that the institution is in a very good place for extending their future facilities to private residents in the precinct. However, one key informant from that institution's operation arm was adamant that the university's waste responsibilities are very clearly defined from the responsibilities of private residents and the council, and that the University has nothing to do with residential food waste (apart from their halls of residence of course). Interestingly, that line of responsibility is blurred in light of the planned Sustainability Neighbourhood (introduced in Chapter 4, 'Dunedin Context and Related Policies'), which will be run for private households renting university-owned flats. In the context of how the issues of anti-social behaviour and waste overlap in the area, enlisting involvement from Campus Watch in the form of pastoral care, this line of responsibility is blurred even further.

6.3.3 Discussion

The results presented in this section revealed the following key barriers to sustainable domestic food waste management practices in the tertiary precinct:

1) There is a lack of food-waste management infrastructure and services in the area for households to make use of to divert their food waste from landfill. At both city council and tertiary institution level there are food waste-related initiatives in motion, but these have not yet come far enough for the residents of the precinct to make use of. The exception of this is the developing composting facility at OP but due to a lack of advertising, this service is not yet widely known. The results revealed markedly split opinions on whether food waste management solutions for Dunedin should be left to the council to deal with through a centralised, city-wide system, or whether a decentralised model that involves and engages the community would be more appropriate.

2) There is a lack of support for private composting activities. Opinions are split on whether private composting as a way to manage domestic food waste should be encouraged in the tertiary precinct: some are of the opinion that it will bring more issues than benefits (through vermin and unsanitary conditions) to the area, while others believe that, especially in the absence of a kerbside food waste collection service, composting should not be discouraged. There also appears to be widespread lack of support for home composting from landlords and letting agencies in the area. The Otago Waste Plan may also act as a barrier to community composting initiatives.

The wider context of waste behaviours in the tertiary precinct contributes (discussed in Section 6.3.2.2 above) to both above barriers. These barriers will be discussed in the ensuing section, with reference to trends in the literature.

6.3.3.1 Centralised and institutionalised or localised with community involvement?

The disparate opinions on the type of food waste management system that would be most appropriate for Dunedin are in line with tensions that are also reflected in the literature. Efficient and centralised systems and infrastructure provided by local government are valuable tools that divert food waste from landfill and help cities move toward a circular economy. While food waste kerbside collection systems are celebrated for their efficiency, writers are now also at pains to point out their shortcomings; a complex problem such as food waste requires complex solutions and narrowly framed policies that simply remove the material out of sight for processing in a remote location are not comprehensive enough to have long term effects. In recognition of the 'wicked' dimensions of food waste, a trend in the literature is now pointing towards multi-dimensional solutions and experiments that address the problem with more holistic strategies.

Tucker and Farrelly's (2016) study on domestic food waste in Palmerston North found that, of the New Zealand environmental issues identified by survey participants, waste and rubbish 'were the second most frequently discussed'. Despite this concern, 78% of respondents still place food waste in their rubbish. Other studies have found kerbside recycling services to be a 'key motivator for recycling and waste minimisation improvements' (Tucker & Farrelly, 2016a, p. 699), both through removing the barriers of inconvenience and also through the snowballing effect that has been found to occur when recycling becomes normalised within a neighbourhood (neighbours influencing each other) (Nigbur et al., 2010). Thus, a kerbside food waste collection service could go a long way to help bridge this awareness-action gap. However, Tucker and Farelly (2016) contend that a kerbside service is not enough as a stand-alone measure, and that a regulatory dimension should be applied through local government policy in order to elicit better pro-environmental waste behaviour in the local population. Such measures should be aimed at raising awareness (through education and information dissemination) and inducing behaviour change (through incentivisation, normalisation and the advocacy of sustainability champions). Acknowledging the challenges faced by local governments through chronic shortages of resources, time and training, Tucker and Farelly suggest that a country-wide standardised methodology would be beneficial to help councils,

institutions, and individuals to address the barriers to sustainable domestic food waste practices through a multilayered approach.

A good example of an efficient kerbside food waste collection system is that which is run by Living Earth for Christchurch City Council. Each year, over 45,000 tonnes of organic waste (including garden waste) is collected from council-issued green bins in private homes in Christchurch and transported to The Organics Processing Plant in Bromley. The organic material is processed efficiently at the plant in a way that ensures vermin and insects are not attracted to it, and within 3 - 4 months it is transformed into compost that is then sold on to the rural sector (Christchurch City Council, n.d.). Christchurch's system is undoubtedly efficient, and it diverts multiple tonnes of food waste from the landfill every year. As mentioned before, the action of separating their food waste from the general waste may have a normalising and pro-environmental effect on residents' habits and attitudes. All these things should be celebrated. However, food waste writers are increasingly questioning whether they are enough on their own. How far do the normalising effects of such effective systems reach into people's connections and values with how we as a society relate to food, to what effect are such systems incentivising people to minimise their food waste, and to what extent do such marvellously efficient systems help to alleviate the invisibility of domestic food waste?

Lake et al. (2020) have been grappling with these types of questions. With their theoretical feet firmly rooted in the framing of food waste as a wicked problem, Lake et al. (2020) envision that a range of 'transdisciplinary, holistic and systematic interventions' (p. 213) are required to address both internal drivers and external processes. In this context, change agents (people such as non-profit activists, policy makers, and motivated individuals within institutions and commercial entities) are highlighted as key influencing forces for sustained change. Each different locality comes with its own complex cultural conditions and can make behaviour change cumbersome to achieve. But with careful analysis of those local complexities, change agents may develop interventions that 'more flexibly respond to the place-based, context-bound specificities of the community' (p.196), resulting in more resilient interventions. Lake et al. (2020) press that by combining design thinking with systems thinking in this way, designers of interventions are encouraged to consider the various environmental, social,

political, and cultural factors that are contributing to food waste issues, to home in on their causes and engage in systems change. To illustrate how their methods might manifest, Lake et al. (2020) point to Transdisciplinary Living Labs (TDLL) as potential spaces for 'co-creation, exploration, experimentation an evaluation' (p. 2010). TDLLs are physical localities where stakeholders from public-private-people partnerships meet to address real-world challenges through collaborative and transdisciplinary experimentation and learning (McPhee et al., 2018). Lake et al. (2020) suggest that institutional models such as TDLLs to 'foster the agency and skill sets needed for growing a movement' (p. 2013) which, over time, might generate local tipping points which can in turn contribute to what becomes a 'critical mass, replacing the dominant attractor of the status quo' (Burns, 2014, quoted in Lake et al., 2020 p. 213).

As a type of TDLL, the abovementioned Sustainability Neighbourhood carries within it the potential to induce behaviour change in the tertiary precinct by normalising and championing sustainable behaviours. However, the socio-cultural and physical barriers that this study has uncovered will not be easily circumnavigated. For a culture change in the area to reach the desired tipping point, it will require incentivising and normalising through both the socio-cultural dimension and physical dimensions (such as strategic signalling within the streetscape), probably best achieved through public-private partnerships.

Other writers, too, advocate for public-private partnerships. Secondi et al. (2015) advocate for the implementation of consumer food waste programmes to be started on selected groups of individuals. The implication of that policy is an anticipated 'cascading effect' (p. 38) whereby the selected group of people pass on their food-waste training to other groups further down-stream (Quested et al., 2013; Secondi et al., 2015). Secondi et al. (2015) 'strongly recommend that local policy makers invest in community-based interventions for reducing food waste' (p. 38).

There is no doubt that the current lack of council-run food waste infrastructure in Dunedin is a barrier to many households that wish to divert their food waste from landfill However, this void in service can also be seen as an opportunity. Policy makers may soon be able to (following appropriate consultation and decision-making processes) launch

improvements to the city's kerbside waste collection service. This could be a deciding moment which will set the course for how sustainability issues are approached in Dunedin. Will they approach the issue with holistic, long-term, and systemic thinking, involving the community through collaboration and partnership? Or will we see more of a one-dimensional approach, where food waste will be dealt with effectively and efficiently, transported out of sight to a remote processing site, sparing our delicate selves from its sight and smell?

6.3.3.2 Should household composting be encouraged?

Whether composting should be encouraged may strike some people as an odd question. It is common knowledge that composting is an activity that can benefit the environment by both keeping food waste out of the landfill while improving the soil. However, as we have seen in this study, the socio-cultural and built environments in the tertiary precinct are, for many local households, not conducive to composting; if mismanaged, food waste can pose as a health hazard rather than produce benefits. These are valid arguments for why composting should be an activity best left alone in many households in the tertiary precinct.

On the other hand, the educational value that composting can offer has been shown in the literature to help communities 'close the loop' on their understanding of the interconnectedness of ecosystems, food, and the circular economy. Christie & Waller's (2019) empirical study on the on-site composting experiences of a group of apartment building residents found that residents' learning experiences continued beyond the activity of composting: '[f]or some residents, participation resulted in a greater awareness of food waste produced. For others, their involvement in on-site composting inspired a greater sense of community, a deepened connection with nature, and a desire to grow green spaces and create positive global change toward sustainability' (Christie & Waller, 2019, p. 97). Christie & Waller's (2019) study shows how composting, although it is technically a food waste *management* method, has the potential to lead to long-term regenerative results, including waste minimisation.

Around the world, the number of tertiary institutions pledging to reduce their waste is growing (Soloviy, 2019). In recognition of the educational value of composting, many progressive institutions are now moving towards processing campus-derived food waste and other organic surplus material on-site, giving 'students the opportunity to see sustainable resource management in action' (Sullivan, 2010, p. 46). As mentioned in Chapter 4 ('Dunedin Context and Related Policies), OP has joined the ranks of these teaching institutions.

In a context-based case study, Boyle et al. (2018) take inspiration from Mang & Reed's (2012) Trajectory of Ecological Design and recommend both a restorative (for the medium term) and regenerative (for the long term) conceptual pathway towards design solutions to address organic waste management issues at OP. Mang & Reed (2012) explain regenerative approaches as approaches that 'seek not only to reverse the degeneration of the earth's natural systems but also to design human systems that can coevolve with natural systems – evolve in a way that generates mutual benefits and greater overall expression of life and resilience. The field of regenerative development and design, which draws inspiration from the self-healing and self-organizing capacities of natural living systems, is increasingly seen as a source for achieving this end. This field is redefining the way that proponents of sustainability are thinking about and designing for the built environment, and even the role of architecture as a field' (Mang & Reed, 2012, p. 8857).

Following the restorative pathway, Boyle et al. (2018) recommend using medium-scale food waste management processes that would allow hands-on human engagement 'with biophilic designs that reconnect people to nature' (p. 55). With minimal mechanical input requirements and built-in redundancy such processes can be flexible, resilient, and economical to set up and run. They also allow for interdisciplinary collaboration and student engagement. OP is now well on the way to have such a system up and running.

From there, Boyle et al. (2018) envision a long-term opportunity for OP to create 'systems-level change in the local community' (p. 56) via the regenerative pathway. By offering organic waste solutions to the wider community beyond the OP campus, OP would be able step forward as a sustainability leader in the local community while inviting collaboration from other local institutions and businesses. In this way, by

opening up to inter-disciplinary and inter-organisational collaboration while simultaneously supporting the local community in achieving sustainable domestic practices and 'closing the loop' through resilient service, education and engagement, OP could help to fill the gap in food waste management service provision in the area. Such goals fulfil both OP's own strategic goals and values (Otago Polytechnic, 2020b) while also aligning with the Guiding Principles of the WMMP 2020 (Waste Minimisation and Management Plan, 2020).

Considering how difficult it is to manage food wase on-site in the precinct, there's even more need to focus on preventing food waste in the first place. The regenerating and educational potential of composting, as shown above, validates the encouragement of composting activities locally. Meanwhile, however, barriers in the tertiary precinct remain on many fronts, making the case for a regenerative-focussed and community-based food waste processing scheme even more compelling. Considering the size of the tertiary precinct, however, it would be unrealistic to expect all households in that area to transport their domestic food waste to the Polytechnic for processing. A higher number of local community composting facilities would therefore be beneficial – especially if the city decides not to go ahead with the collection of organic waste in the future.

By keeping domestic food waste local, visible, and valued, it can be used to educate on and promote awareness about food, its origins, its destination, and, importantly, its multi-layered impacts. Local organisations that strive towards their own sustainability goals would be well advised to take leadership from OP on their food waste approach. Collaborative partnerships working together on local, community-focused domestic food waste in the tertiary precinct have the potential for powerful shifts in the area's collective paradigms.

6.4 Conclusion

This chapter has shown that both tangible and abstract barriers on socio-cultural, physical, and systemic levels hinder residents in the tertiary precinct from engaging in sustainable food waste management practices at home. Currently, for a household in the tertiary precinct to be successful in diverting their domestic food waste from landfill it

would require dedication, education, time, money, and the right situation - both physically, socially, and contractually. Further barriers to pro-environmental behaviour, reflecting the theoretical framework of the awareness-action gap (Blake, 1999; Kollmuss & Agyeman, 2002), have thus been identified. The chapter also revealed differences in opinions on which methods and policies would best be suited to remove these barriers for tertiary precinct households, where the responsibility for domestic food waste lies, and to what extent private households in the area should be encouraged to manage their own food waste.

There was acknowledgement among participants that policies and planning are necessary components of our social system that are ultimately in place to protect people and the environment. However, the results also point to a need for these components to be nuanced and current enough to enable society and the environment to function optimally. Some planning-related opportunities exist in the tertiary precinct (and the wider city) for policies and collaboration between the council, local institutions, and members of the community to elevate how food waste is dealt with. How, and to what extent, these opportunities are acted upon, will be a question of timing, good will, agendas, and public opinion.

Chapter 7: Conclusion

This final chapter will summarise and reflect on the key findings of this research. It will also provide recommendations for local government and institution policy makers. Areas of future research that may enhance knowledge around the topic of domestic food waste will also be suggested.

The aim of this research was to 'explore the barriers to, and opportunities for, sustainable domestic food waste practices in the tertiary precinct' with an added interest in the potential impact of the local built environment. This aim was addressed through two research questions:

Research Question 1

1A: What are the barriers to sustainable food waste minimisation practices among households in Dunedin's tertiary precinct?

1B: Does the built environment influence residents of the tertiary precinct's ability to minimise their domestic food waste?

Research Question 2

2A: What are the barriers to sustainable food waste management practices among households in Dunedin's tertiary precinct?

2B: Does the built environment influence residents of the tertiary precinct's ability to manage their domestic food waste sustainably?

7.1 Key findings

This research was inspired by a delayed awakening in New Zealand to the monumental issues that food waste presents to the world. The international food waste movement has already influenced policies in many countries overseas (Principato, 2018; von Massow et al., 2019). Although New Zealand has not kept pace with that progress, now is an exciting time for New Zealand as awareness is growing among policy makers and communities around the country. There is much ground to be covered, but although more

courageous planning and coordination is sorely needed to achieve unified goal-setting and direction (Mirosa, 2019), we can celebrate the fact that there are many initiatives in motion both nationally and locally that all add to a growing New Zealand movement (Love Food Hate Waste New Zealand, 2020; Mirosa, 2019; WasteMINZ, 2020a; Webb, 2020).

This sense of timing is very apt for a domestic food waste study based on the tertiary precinct, as many exiting things are happening that may all have an impact and that will provide more opportunities for food waste minimisation and sustainable management. There is increased focus from central government on the food waste problem, and in Dunedin, the DCC's WMMP 2020 has set ambitious waste reduction targets for the city. While planning has commenced on a new landfill to be developed for Dunedin, the DCC is already considering incorporating organic waste into its kerbside waste collection service. UO is piloting a new sustainability neighbourhood and is developing plans and technology for processing the institution's food waste, and OP has developed a composting facility with a strong focus on its educational value and regenerative potential. Alongside these initiatives there is growing engagement within community groups around the city (e.g., KiwiHarvest, community pantries, etc) and importantly, a street safety and amenity upgrade that has potential to bring food waste in to focus through environmental design is being planned for selected streets within the precinct. With so many initiatives pointing in the same direction, a golden opportunity now exists to put the spotlight on food waste within the built environment in the tertiary precinct, as well as policies and services that affect the area.

The body of food waste literature is relatively young - at least in New Zealand. A literature review revealed that there are still aspects about, and relationships to, domestic food waste that have not yet been researched extensively. Young adults have already been identified as key contributors to food waste and it was therefore fitting to conduct a study on barriers to sustainable food practices for this demographic group. The relationship between the built environment in urban settings and food waste practices has received limited attention in the literature, adding another unique angle to the direction of the study.

The study involved an online survey and key informant interviews, soliciting food waste-related opinions and experiences from residents of the tertiary precinct and a diverse group of key informants. The data collected from this study provided a basis upon which an informed picture on domestic food waste in the tertiary precinct fits within the existing local socio-cultural conditions and built environment. In addition, the research uncovered opinions among key informants and survey participants on preferred food waste services and infrastructure.

By uncovering these insights, this study has achieved its aim while also providing a valuable addition to the literature. Throughout all the results, there is a strong sense coming through that it is high time the issues of domestic food waste receive more attention in Dunedin.

7.1.1 Barriers to food waste minimisation

Most of the barriers and issues that surfaced during this research are layered and inter-related to a high degree. Separating them into distinct categories has been difficult. It is important that readers of these findings keep in mind the fluidity of the subjects at play. Chapter 5 answered **Research Question 1**:

> **1A:** What are the barriers to sustainable food waste minimisation practices among households in Dunedin's tertiary precinct?
>
> **1B:** Does the built environment influence residents of the tertiary precinct's ability to minimise their domestic food waste?

Results strongly indicated a low level of appropriate domestic skills, skills in discerning edibility, and value-based appreciation of waste among the young precinct population. Many also appear to lack an understanding of the difference between food waste minimisation and food waste management. In-depth surveying would be required to quantify this finding, which may reflect trends that run deeply within parts of New Zealand's culture and social systems. This was also the case for an apparent lack of understanding of the wicked problem of food waste as a global issue and environmental threat, translating into apathy and lack of interest in engaging in the issue. This finding presents opportunities for increased social marketing and awareness campaigns which

have the potential to strengthen people's understandings of the food-environment connection, and empower them to make choices and take actions to reduce their food-related environmental footprint (Bernstad, 2014; Campbell-Arvai, 2015).

Residents who navigate past the existing social and cultural hurdles are further hindered on the physical and systemic fronts. It appears that the demographic make-up of many shared households, coupled with certain aspects of the built environments in the precinct, make it difficult for some to minimise and manage their food waste at home. Living in large households in which individuals have different dietary requirements and time schedules make it difficult to coordinate food shopping and cooking, and therefore also to avoid food waste. These types of conditions reportedly impact on available storage for food as well, further compounding issues by increasing chances for 'lost in fridge' scenarios. The built environment was also linked to difficulties in minimising food waste through the availability of convenience food: it is difficult to stick to one's plans to cook already purchased food if hunger strikes while away from home and surrounded by the promise of instant satisfaction from fast food (Evans, 2011, 2014).

Some of these barriers to food waste minimisation are very clear, while others are more indirect. Nevertheless, they present real hindrances on several levels, including the built environment, that add to precinct residents' difficulty in minimising their domestic food waste.

7.1.2 Barriers to sustainable domestic food waste management

Chapter 6 answered **Research Question 2**:

- **2A:** What are the barriers to sustainable food waste management practices among households in Dunedin's tertiary precinct?
- **2B:** Does the built environment influence residents of the tertiary precinct's ability to manage their domestic food waste sustainably?

Results also identified multiple barriers to sustainable waste management in the precinct. The lack of infrastructure, service, and an enabling built environment appear to be the most eye-catching aspects in this respect.

Residents who find it impossible to process their own food waste on-site are currently forced to send their food waste to landfill unless they can find an alternative site nearby. The only available service in the area for domestic food waste management is OP's new composting facility. However, the availability of this service is currently so low that virtually no households are taking advantage of it. With no council kerbside service or infrastructure available, households who wish to divert food waste from landfill must do so by their own initiative. Doing so proves difficult for many households due to a restrictive built environment. Fine-grained urban neighbourhoods and high levels of paved surfaces came through as the most conspicuous reasons, although the low amount of gardening activity also seems to have an impact, as did a high turn-over of residents, a lack of know-how and even lack of support from landlords. In addition, Rule 7.6.12(e) in the Otago Waste Plan appears as a potential barrier to community-based composting initiatives.

It became clear from the results of this study that there a significant interest within the precinct population to divert their domestic food waste from the landfill. However, as was the case for the previous research question, a need for appropriate education and support in relation to food waste management was also evident (Section 6.1). Low amenity levels, highly visible litter and broken glass in many streets, and normalised tendencies for poor waste separation behaviour in the area all appear to send signals of low care that have a negative effect on some precinct residents' motivation to 'do the right thing' (Quested et al., 2013; Secondi et al., 2015).

There was a strong sense coming through from survey results that a council-run kerbside collection service for domestic food waste would have a high uptake in the tertiary precinct. There are also residents in the precinct who are inspired and motivated to manage their own domestic food waste on-site, but support and facilitation is called for to empower these sustainability champions to successfully navigate the barriers that exist in the area. These physical and systemic barriers present opportunities for local government, institutions and residents to find localised solutions through collaboration and regenerative planning strategies (Boyle et al., 2018; Bruni et al., 2020; Slater & Aiken, 2015).

7.1.3 Link to awareness-action gap

The awareness-action gap (Blake, 1999; Kollmuss & Agyeman, 2002) serves as a useful model to help us conceptualize why some individuals do not engage in pro-environmental behaviour even when they are aware of an environmental issue (see Figure 2.4). The essence of this model is that different individual, institutional and social barriers hinder people from doing the right thing, be it a lack of time, lack of resources, lack of information or a feeling that one's individual action will not make a difference. Barriers of multiple origins were found throughout this study. Some can be described as barriers of practicality, such as lack of time and an urban environment that literally blocks people from carrying out yard activities. Others were more difficult to pinpoint; the effect of broken glass and litter in the streets, for example, is more indirect and harder to prove. The sum total effect of these barriers is a residential population where many households are left disempowered to divert their domestic food waste and even to a certain extent minimise it, resulting in a weakened locus of control (Blake, 1999; Kollmuss & Agyeman, 2002; Skinner et al., 2012; Tucker & Farrelly, 2016a). A simplified depiction of Blake's (1999) model, tailored to address domestic food waste practices in the tertiary precinct, is depicted in Figure 7.1 below.

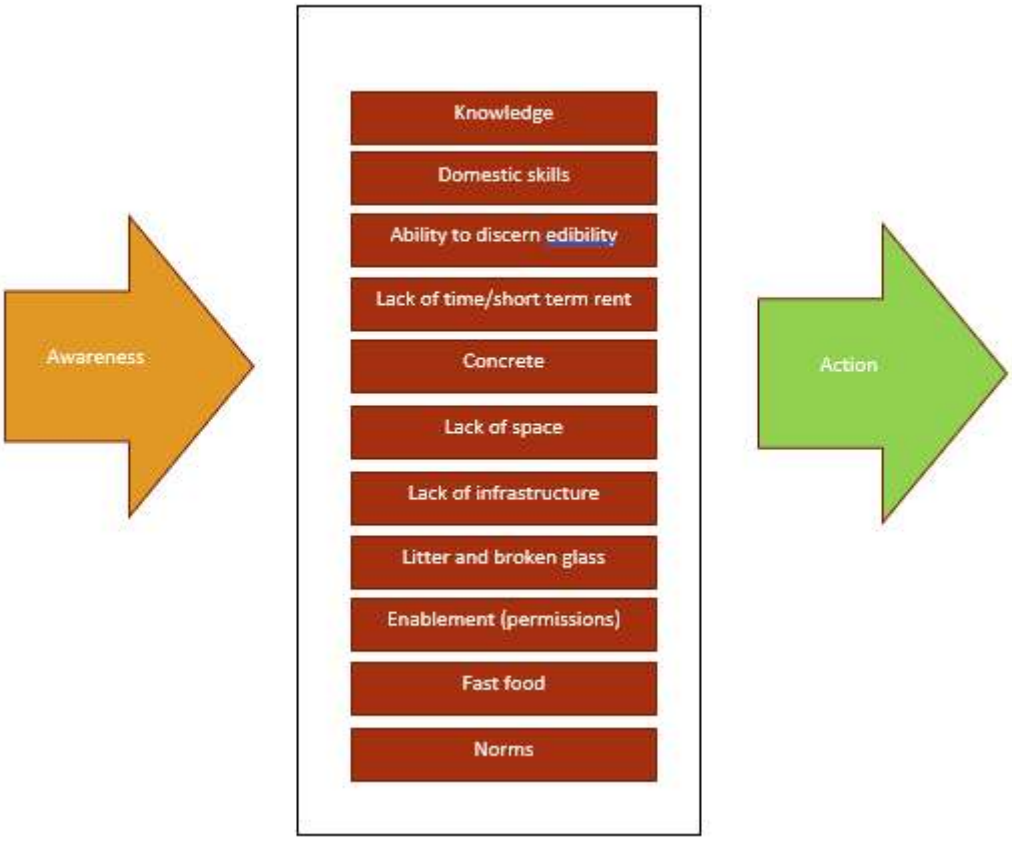

Figure 7.1: Simplified model of Awareness-Action gap for the tertiary precinct

7.1.4 Opinions on ideal models for food waste management in the city

In addition to the barriers mentioned above, this study found that opinions vary between actors within organisations and institutions - both on the question of where the responsibility for dealing with food waste lies, as well as through which kind of planning approach domestic food waste should be dealt with in Dunedin.

Assumptions of responsibility seem to run between two general groups: some see domestic food waste as something that society in general should take responsibility for (and therefore the whole of society should work together to solve it), and some tend to see domestic food waste as something that either only the producer of the food waste (the household) or the council should take responsibility for.

Opinions on which food waste management solutions would work best for households in the precinct also trended along two camps. One group advocated for localised, community-based solutions, promising the benefit of long-term educational value that would loop through and eventually manifest as positive impacts on food waste through minimisation. This group tended to see food waste as a symptom of larger societal issues (e.g., caused by modern society's relationship to food). The other group tended to refer to food waste as a more straight-forward and localised problem that could be addressed well with industrial-style solutions in place, efficiently run by the council or a contractor with processing taking place at a remote site. Both models would bring the city towards its aspirations of a circular economy and Zero waste, which will be applaudable. However, the latter model has the potential to segregate consumers from the process involved in achieving that circular economy, thereby potentially robbing them of an opportunity to 'connect the dots' and start to see more value in minimising their waste in the first place (Crocker, 2012). The former model has the potential to be more labour intensive in terms of manual labour and administration if employing low-tech and small-scale systems. However, its regenerative and educational potential would be very valuable in terms of giving food waste increased visibility in the urban landscape, and a chance to reconnect people back to the natural process of life itself (Boyle et al., 2018; Christie & Waller, 2019; Slater & Aiken, 2015; Tucker & Farrelly, 2016a).

Perhaps there are more than two options to choose from now that Dunedin's food waste policy is at a crossroads. Perhaps there is room for *both* efficiency *and* regenerative models (see Section 6.4.3.1 and 6.4.3.2). How far they are willing to collaborate, how far ahead in time they are willing to gaze, and to what extent they are willing to break the silence on food waste in the urban landscape is now in the hands of planners and decision makers.

7.2 Recommendations

The findings from this study have concluded that many barriers exist in the tertiary precinct for individuals and groups to both minimise domestic food waste and manage it in sustainable ways. The study has also identified intersections between several projects, both new and in the pipeline, where opportunities exist for tertiary institutions, local

government, community groups and individuals to collaborate on bridging the 'awareness-action' gap.

Through already existing strategies and policies, Dunedin's local government and tertiary institutions are well placed to further sustainability through food waste initiatives without delay. With the right mixture of willingness, funding, and synchronised timing these opportunities have potential to influence both the built environment and behaviour change in the tertiary precinct – removing any reservations about which of the two should come first.

This section will offer recommendations to local government and tertiary institutions that could help break down some of the identified barriers, encourage and enable the local population to adopt sustainable household practices, and lay down fertile ground on which the ethos of sustainability may flourish. These recommendations are targeted to specific organisations, but focus heavily on collaboration, a wholistic planning approach, influencing the built environment through signalling and infrastructure, and careful timing.

Table 7.1: Recommendations for the Dunedin City Council.

Recommendations for the Dunedin City Council	
Recommendation 1	Collect improved data on domestic food waste occurring in the city by suburb through robust and regular auditing methods. This would be in line with Priority 2 of the Local Government Waste Management Manifesto and reflects Recommendation 2 of the Mirosa Report to establish a detailed national food waste baseline to determine where the 'hotspots' are.
Recommendation 2	Conduct a survey to gauge the tertiary precinct/Dunedin population's understanding and engagement of the food waste issue. Data collected would support waste audit data and inform education and awareness raising efforts.
Recommendation 3	Increase funding for and expand current waste minimisation education programmes and coordinate with other waste minimisation developments and initiatives as part of a multi-pronged strategy. Education and awareness raising programmes need to be relatable, targeted, measurable and based on robust data. This reflects Recommendation 29 of the Mirosa Report to sufficiently resource food waste prevention initiatives.
Recommendation 4	Incorporate collection of organic waste into the city's kerbside waste collection service in the next 10-year plan 2021-2031 as per Option 1 presented in the April 2020 public engagement. This would be in line with the WMMP 2020

	Objective 2 ('the community has access to diverted material services'). It would also demonstrate leadership, engagement, and commitment to the city's stated guiding principles of Zero Waste and Circular Economy, manifested in their vision: 'Dunedin is actively committed to zero waste inclusive of a circular economy to enhance the health of our environment and people by 2040'.
Recommendation 5	Incorporate food waste into current and future recycling hubs in the tertiary precinct. Collaborate with sustainability champions within the local community, student bodies and tertiary institutions to use this as a basis for community composting projects. This type of infrastructure would be useful for local households with limited space and promote local food resilience and engagement. It would also give food waste more visibility within the streetscape and community and align with the Proximity Principle - one of the guiding principles of the WMMP 2020: 'The highest use (for used materials and products) with the shortest possible distance'.
Recommendation 6	Collaborate with local institutions, student bodies and community members to install and maintain a community pantry. This would align with the WMMP Objective 3: 'The community has access to diverted material facilities'. Community pantries could also be incorporated into the DCC's education outreach for waste minimisation.
Recommendation 7	Change the kerbside collection schedule for glass and mixed recycling for both to be collected once per week, on the same

	day of the week, instead of once per fortnight. This would help address the 'high demand for waste and recycling services in the tertiary area' which was identified through the Waste Assessment 2018 by addressing both the confusion that students in the area experience around the kerbside collection schedule, as well as the insufficient capacity of the bins.
Recommendation 8	Install public placement bins at strategic points in the tertiary precinct to cater to the high pedestrian traffic in the area. Increase capacity to include food waste once infrastructure is in place to allow for it. This would be in line with the WMMP 2020 Objective 3 Policy for the DCC to continue to grow a network of public places recycling bins.
Recommendation 9	Incorporate highly visible food waste collection points into the design of the tertiary precinct safety and amenity upgrade plans. This could be worked in with small hubs that invite socialising and food sharing while signalling Dunedin's zero waste aspirations such as micro gardens, communal BBQs and community pantries. This type of installation would be in line with the Tertiary Development Plan 2008 (8.4 Proposed Actions [Environment]: 'Develop new micro-parks/village greens where possible' and 'Create communal, covered eating areas throughout the campus, including free outdoor BBQ facilities').

Recommendation 10	Invite Kāi Tahu to partner in a food waste forum to bring together actors and stakeholders in the community interested in finding solutions to domestic food waste in Dunedin.
Recommendation 11	Evaluate existing plans, policies and programmes through a food waste 'lens'. Determine how food waste fits in with these elements, and how they could be applied to encourage food waste-related community initiatives and improve town & gown collaborations specifically related to consumer food waste.
Recommendation 12	Conduct an evaluation of current food waste-related decision-making processes to determine whether considerations of Te ao Māori are being sufficiently incorporated.

Table 7.2: Recommendations for the Otago Regional Council

Recommendations for the Otago Regional Council	
Recommendation 1	Incorporate review and amendments to all greenwaste and composting provisions into the upcoming review of the Otago Waste Plan. Design unambiguous rules in the resultant new plans, containing tiered volume quantities that will enable community organisations to lawfully compost small amounts of food waste while simultaneously avoiding or minimising adverse effects on the environment. Allowable quantities of composting would need to be based on predicted discharges onto or into air, land or water for those specific quantities. Tiered allowable quantities must be measurable by lay persons

	(e.g., by cubic meterage). A good example of such an approach can be found in Section 8 of the Auckland Council Waste Management and Minimisation Bylaw 2019 and Sections A145-150 of The Auckland Unitary Plan (Auckland Unitary Plan Operative in Part, 2016; Auckland Waste Management and Minimisation Bylaw, 2019). Making the activity of small-scale composting a permitted activity, regardless of whether the stock originates from the site of processing or not, while ensuring the permitted quantities of compost are small enough not to have the potential to discharge contaminants in harmful quantities would help to enable small-scale and community-based composting rather than hinder it. This would be in line with the RPS 2019 policy 4.6.6: 'Promote an integrated approach to the management of the use, storage and disposal of waste materials'.
Recommendation 2	As an extension of Recommendation 1, include requirements for small composting facilities to register their operation with the Council. Such a register would allow the Council to ensure community operated facilities' compliance with rules and continued monitoring. At the same time, it could open channels for education and collaboration. This would be in line with the RPS 2019 Methods 7.1.5 ('Regional, city and district councils will provide information and guidance on waste minimisation and management') and 9.1.2.c ('Regional, city and district councils may advocate for the implementation of the waste hierarchy throughout the region').

Table 7.3: Recommendations for the University of Otago

Recommendations for the University of Otago	
Recommendation 1	Discontinue the current skip service and replace it with a service offering freight of large household items to the Rummage resource recovery facility, a charity organisation for on-selling or a similar initiative. Continue to collaborate with OUSA and other organisations on skip diversion initiatives. This could encourage regular users of the skips to engage more with their own waste, develop better separation behaviours and make use of council services, such as the recycling hubs. This would align with the University's Sustainability Strategic Framework 2017-2021 Strategy 4: Become a zero waste institution.
Recommendation 2	Take leadership from the Otago Polytechnic: Once the University has launched a food waste processing system for the institution, offer access to that system to residents of the tertiary precinct who are students at the University. This would align with the University's Sustainability Strategic Framework 2017-2021 Strategy 6.2.b): 'Create and participate in community-University groups to identify possible areas for joint activity'.
Recommendation 3	Once the University has launched a food waste processing system for the institution, include food waste bins to the existing three-bin recycling placement bins around campus. This would align with the University's Sustainability Strategic Framework 2017-2021 Strategy 2.2.j): 'Manage and minimise

	the output of solid wastes, discharges of liquid wastes and airborne contaminants'.
Recommendation 4	Incorporate edible plantings into the campus grounds. Provide signalling that informs people how organic waste from the university grounds is recycled by the University and re-introduced to the campus grounds as plant nutrients. This would align with the University's Sustainability Strategic Framework 2017-2021 Strategy 2.2: 'Promote sustainability in the built environment'.
Recommendation 5	Collaborate with local institutions, student bodies and community members to install and maintain a community pantry. This would align with the University's Sustainability Strategic Framework 2017-2021 Strategy 2.4.b): 'Provide waste minimisation facilities and guidance on campus and in departments'.

Table 7.4: Recommendations for Otago Polytechnic

Recommendations for Otago Polytechnic	
Recommendation 1	Increase funding to enable wider advertising of the composting facility to build awareness within the local resident population that the service is open to local private households.

7.3 Future research

The scope of this study was niche and limited to barriers to sustainable domestic food waste practices experienced by the (mostly) young adult population in the tertiary precinct. However, considering that the majority of the students that reside in the tertiary precinct come from outside of Dunedin, the findings produced by this research have linkages to the rest of New Zealand. Replicated investigations into young adults' involvement in food waste and sustainable household practices in other centres with other types of built environments (including rural areas) may produce different patterns of environmental engagement and could be valuable for policy makers, food waste researchers and educators alike.

Research aiming at gauging how well young adults in New Zealand understand the connections between mismanaged domestic food waste and GHG emissions could be used to inform future education campaigns and school curriculums.

This thesis has discussed how differing individual dietary requirements may affect the ability of large households to minimise their domestic food waste. As dietary trends continue to develop, this would be an interesting and useful topic for researchers to delve into further.

Likewise, as the COVID-19 pandemic is disrupting private and public systems throughout the world, further exploring the types of impacts it is having on domestic food waste practices and quantities could produce useful data for policy makers and future researchers, especially in the fields of Human Geography, Food Science, Marketing and Public Health.

Researchers in these fields may equally be interested in further exploring linkages between household food waste and the availability of convenience food and whether the purchase of 'healthy' convenience food result in less domestic food waste than 'unhealthy' convenience food does.

7.4 Concluding argument

Domestic food waste is a part of an immensely complex and serious global problem that all households should be empowered and enabled to engage with at a local level. Yet, although many people feel that throwing out food is wrong, the wicked nature of the problem makes it a difficult thing for households to avoid - the reasons for which are often hard to distinguish. A lack of food waste infrastructure and enabling built environments may be the first reasons to spring to mind. However, the socio-cultural aspects of many people's modern everyday lives may be equally formidable barriers, although more diffused and harder to pin down.

Dunedin's tertiary precinct was selected as an ideal area to conduct a study on the barriers that households experience in this regard largely due to its high rate of large households with young adults. Results from this research have highlighted how the importance of food waste minimisation is not sufficiently recognised – both among the tertiary precinct population and some local government and tertiary institution staff – revealing a preoccupation with the management of food waste rather than the prevention of it, and perhaps even an acceptance that food waste is inevitable. The research also revealed that constraints exist on multiple fronts that hinder private households in this area to both minimise and sustainably manage their domestic food waste. Many of those barriers are layered and inter-connected and appear in both the physical and mental realms - ultimately forming a complex labyrinth for residents to navigate. The result is a population that to a large extent is left disempowered from engaging with the issue in a meaningful and lasting way.

Encouragingly, we are now on the cusp of a time of great improvements in this field; some exiting projects are in motion within institutions of both town and gown. Now is the time to enable both the community and local institutions to regain a respect for the food we eat and all that it entails - something that can be achieved through collaboration, long-sighted urban design, and holistic planning.

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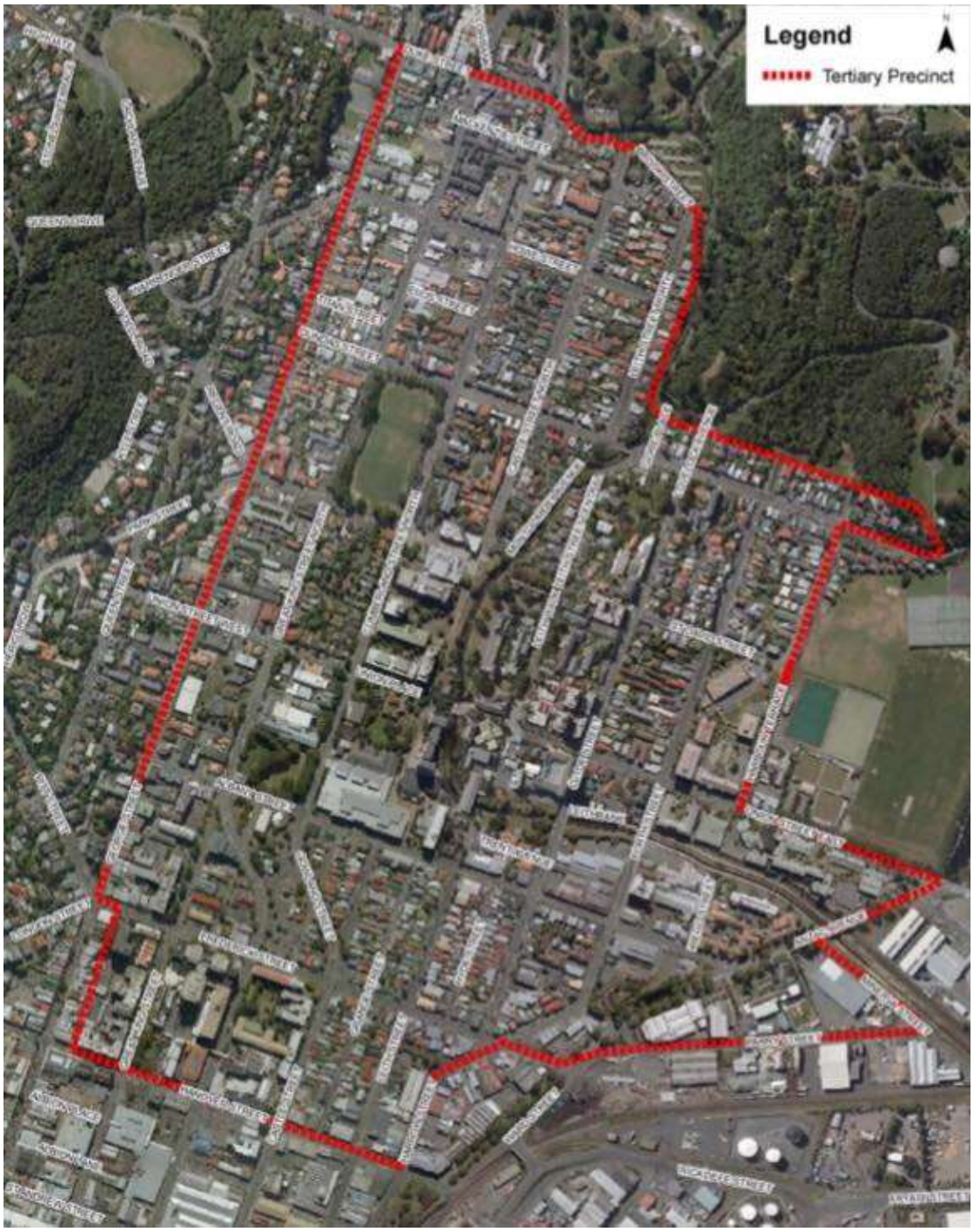
Appendices

Appendix A: Map defining the North Dunedin tertiary precinct.



Source: Tertiary precinct development plan 2008.

Appendix B: List of international Policies

Country	Target population	Policy name/promoter
EU	All	EU parliament voted to introduce farm-to-fork targets to reduce EU food waste
Belgium	All	Bruxelles Environment Agency began anti-waste training workshops
Denmark	All	"Denmark without waste"
Finland	All	"Towards recycling society – the National Waste Plan 2016"
France	All	The ADME created information campaign in 2005 with the goal of informing citizens about food waste
France	Consumer	Grenelle II
France	Retailers/food bank	"Lutte contre le gaspillage alimentaire"
Germany	All	Too good for the bin
Greece	All	National Waste prevention strategic plan
Ireland	All	S1 508
Italy	All	Law 19 August 2016 n.166
Malta	All	Waste Management plan for the Maltese Islands 2014-2020
Norway	All	Agreement to reduce food waste
Netherlands	Food companies	No waste network
Portugal	All	Portugal creates commission to tackle food waste
UK	All	Courtauld agreement
Sweden	Distribution companies	Reducing food waste through social innovation
USA	Food banks etc.	US. 2030 food loss and waste reduction goal
Brazil	All	Save food Bazil
China	Consumers	Clean your plate
Hong Kong	All	Blueprint for sustainable use of resources 2013-2022

Source: Principato, 2018 pp. 40-41.

Appendix C: List of international Initiatives

Country	Initiative
Belgium	GreenCook 2010
Denmark	Food Bank 2009
Germany	Food Waste TV 2010
Ireland	Appetite for Action
France	Waste Prevention in School
Italy	Last Minute Market
Netherlands	Sensible Fresh Food Guide
UK	Feeding the 5000

Source: Secondi et al., (2015) p. 28

Appendix D: Survey Questionnaire

1) Consent to participate

I have read and understood the subject information provided in this consent form. I understand that my participation is entirely voluntary and that I may decline to participate in the survey or that I may withdraw from it at any time. I understand that there is no guarantee that this survey will provide any benefits to me. I have had sufficient time to consider the information provided. I understand that all of the information collected will be kept private and that the results will be used to examine existing barriers to food waste minimisation and management practices among households in Dunedin's tertiary precinct.

- ☐ Yes
- ☐ No

2) Are you a resident of Dunedin's tertiary precinct?

(Please circle one of the options below)

- ☐ Yes
- ☐ No

3) Which option best matches your occupation status?
(Please circle one of the options below)

- ☐ Student
- ☐ Professional
- ☐ Other

4) If you are a student, what are you currently studying?
Free text _____

5) How many people live in your household, including you?

Free text _____

6) Please read the statements below and rank them in order of importance according to your own personal views.

Statement	Ranking (1-5)
Food waste represents a waste of the world's resources such as land, water, and nutrients	
Food waste is unethical	
Emissions from food waste contribute to climate change	
Food waste is a waste of my money	
Placing food waste in the recycling bin causes contamination and wastes the council's resources	

7) Does the house or flat you live in contain some outdoor, ground-level space, such as a back yard?
(Please circle one of the options below)

- Yes
- No

8) How satisfied are you about your household's ability to minimise food waste?

(Please circle one of the options below)

Very satisfied satisfied neutral unsatisfied very unsatisfied

9) What kind of methods does your household use in order to minimise or prevent domestic food waste, if any (e.g., making a shopping list, eating leftovers)?

Free text _____

10) What prevents your household from minimising your domestic food waste?

Free text _____

11) What kind of methods does your household use in order to prevent throwing food waste in the weekly rubbish collection bin/bag, if any (e.g., worm farming, composting, feeding animals)?

Free text _____

12) What prevents your household from keeping food waste out of the weekly rubbish collection bin/bag?

Free text _____

13) Does the built environment (e.g., physical infrastructure, roads, open spaces, buildings, paving, etc.) in your neighbourhood prevent you or your household from minimising food waste?

(Please circle one of the options below)

- Yes
- No

If you indicated 'yes' to Question 11, please explain further in your own words:

Free text _____

14) Does the built environment in your neighbourhood prevent you from diverting food waste from the city landfill?
a) Yes
b) No

If you indicated 'yes' to Question 14, please explain further in your own words:

Free text

_____

15) Please indicate which of the two below options for diverting food waste from the rubbish tip you would prefer if they were offered in your neighbourhood:

- The use of bins specifically issued for food waste, collected once per week by the city council
- The use of bins specifically issued for food waste, emptied by each household at community composting hub in their neighbourhood, at times that suit each individual household.

16) If a community garden and composting hub complex were available in your neighbourhood, would you take part in it?
(Please circle one of the options below)

- Yes
- No

17) What do you think is the most challenging thing about food waste?

Free text

_____

18) Do you have any suggestions to how food waste issues could be addressed by the council in the tertiary precinct?

Free text

_____

19) Would you be interested in attending a focus group to allow for a more in-depth discussion on food waste-related issues in your neighbourhood?
(Please circle one of the options below)

- Yes
- No

If you indicated 'yes' to Question 17, please provide your name and email address below:

Free text

_____

Appendix E: Survey advertisement

This survey is part of a Master of Planning research project, looking at opportunities for, and barriers to, sustainable household food waste practices in the tertiary precinct.

We are interested in hearing how your flat or household deals with your food waste, and what makes it difficult for you to manage it. Results will be anonymous and used to form recommendations for how city planning can address food waste issues in the tertiary precinct.

If you wish to take part in this exciting project, click on the link to the 10-minute survey and have your voice heard!

Food waste quick facts:

- NZ households throw out 2.84 kg food each week, on average – 54% of which is avoidable (based on a 2015 waste audit).
- Food rotting in landfills creates the greenhouse gas methane.
- Food waste is a misuse of resources such as land, nutrients and water.
- Shopping lists, meal planning and 'leftover cuisine' are great tools for minimising food waste.

Appendix F: List of roles held by key informants

Unique ID#	Alias	Role
1	Tertiary education staff member #1	Sustainability champion involved in community initiatives Staff member at a local tertiary institution Former tertiary student
7	Tertiary education staff member #2	Sustainability champion Staff member at a local tertiary institution
3	Food Waste researcher #1	Food waste researcher and expert Staff member at a local tertiary institution
4	Local Government Official #1	Local government staff member with expertise in waste minimisation and management
5	Local Government Official #2	Local government staff member with expertise in waste minimisation and management
6	Local Government Official #3	Local government staff member with expertise in urban design
10	Local government official #4	Local government staff member with expertise in waste minimisation and management
12	Local government official #5	Local government staff member with expertise in waste management
13	Local government official #6	Local government staff member with expertise in waste management
11	Community garden champion #1	Community organisation member Tertiary student
2	Sustainability expert #1	Sustainability and waste consultant

8	Sustainability champion #1	Student body representative
9	Waste management expert #1	Staff member at a local tertiary institution with expertise in waste management
14	Group interview participant #1	Tertiary student
15	Group interview participant #2	Foundation year student
16	Group interview participant #3	Tertiary student

Appendix G: List of topics for discussion in interviews

- Existing issues related to food waste issues in the tertiary precinct in general

- Existing barriers to food waste minimisation in the tertiary precinct
  - Challenges presented by the built environment
  - Opportunities presented by the built environment

- Existing barriers to sustainable food waste management in the tertiary precinct
  - Challenges presented by the built environment
  - Opportunities presented by the built environment

- Policies and planning documents
  - Is the scope for food waste wide enough?
  - Do they incorporate the built environment sufficiently?
  - Do they allow for decentralised composting?

- Local community engagement
  - Results received from previous public consultation
  - Where does the responsibility for sustainable domestic food waste practices sit?

- Future direction
  - What would interview participants like to see for the future direction of food waste policy making in Dunedin

- Views on potential future organic waste kerbside service and infrastructure in Dunedin

- The viability of community gardens in the tertiary precinct

- The viability of decentralised composting hubs in the tertiary precinct

Appendix H: Ethics application

UNIVERSITY OF OTAGO HUMAN ETHICS COMMITTEE
APPLICATION FORM: CATEGORY B
(Departmental Approval)

Please ensure you are using the latest application form available from: http://www.otago.ac.nz/council/committees/committees/HumanEthicsCommittees.html

1. University of Otago staff member responsible for project:

Surname	*First Name*	*Title (Mr/Ms/Mrs/Dr/Assoc. Prof./Prof.)*
Connelly	Sean	Dr

2. Department/School:

School of Geography

3. Contact details of staff member responsible *(always include your email address)***:**

Dr Sean Connelly
Rm 4C25 Level 4 Richardson Building
Email: sean.connelly@otago.ac.nz

4. Title of project:

Exploring barriers to food waste minimisation and management practices among households in Dunedin's tertiary precinct

5. Indicate type of project and names of other investigators and students:

Staff Research	☐	**Names**	
Student Research	X	**Names**	Liv Elisabeth Boyle
Level of Study (e.g. PhD, Masters, Hons)			Master of Planning
External Research/ Collaboration	☐	**Names**	
Institute/Company			

6. When will recruitment and data collection commence?

Recruitment for data collection is expected to begin on the 1st of July 2020 and the data collection from the 13th of July 2020.

When will data collection be completed?

31st of October 2020

7. Brief description <u>in lay terms</u> of the aim of the project, and outline of the research questions that will be answered (approx. 200 words)**:**

This research will seek to examine the types of barriers that exist that prevent households in Dunedin's tertiary precinct (as defined by the Dunedin City Council) from both minimising and diverting their food waste from the waste stream. The study incorporates considerations of how the built environment plays a role and will offer recommendations on how city planning can help address the issue of food waste in Dunedin.

A review of planning documents relevant to Dunedin will be carried out, and the views of DCC staff, tertiary institution staff, student representatives, tertiary precinct residents and representatives from local food networks will be explored. This will help the researcher understand how barriers to sustainable household food waste behaviours in the tertiary precinct can be supported from a planning perspective.

The study will be guided by the main research question:

What are the barriers to food waste minimisation and management practices among households in Dunedin's tertiary precinct?

To logically structure the research project, the main research question is divided into the following sub questions:

- What measures do households in the tertiary precinct currently employ to minimise food waste?
- Which methods do most households in the tertiary precinct currently employ for food waste disposal?
- How does the physical environment in and around North Dunedin prevent or enable residents from diverting food waste from the waste stream (such as composting)?

8. Brief description of the method.

This study will employ multiple methods, including: a literature review, document analysis (including grey literature), semi-structured face-to-face interviews with identified key informants, an online opinion survey and one focus group.

Key informants for interviews include local government staff, tertiary institution staff (who will be interviewed in their professional capacity), student representatives, and representatives from local food networks.

Survey and focus group participants will be private residents of the tertiary precinct (students from residential colleges will not be participating). It is hoped that the sample size for the survey will be 100, while the focus group would be limited to six participants.

Professional key informants will be asked to draw upon their expertise of policy documents or food waste research. Focus group and survey participants will be asked to draw upon their personal experiences with domestic food waste behaviours in the tertiary precinct.

Interviews:
Interview participants will be contacted initially by telephone and/or email where they will be asked if they are willing to participate in a semi-structured interview that will take

up to one hour. The interview will take place either in person or over Zoom and will be arranged at a time which is convenient for them. The contacts of these participants will be acquired through websites and referral from existing key contacts who have consented to be involved in the research.

Written, informed consent will be acquired before the start of the interview. Participants will be provided with an Information Sheet (see appendix), and they will be allowed enough time to read it and discuss aspects of the information sheet with the researcher. This will be sent out at least 24 hours before the scheduled interview through email. The information sheet will include the aim and focus of the research; the nature of inputs being sought from participants; and the protocols of collection, storage, and future use of the data.

At the beginning of each interview, participants will be asked to sign a consent form to confirm that they have understood the information provided and what they are being asked to do. Participants will be informed that every attempt will be made to protect their anonymity unless they explicitly state they wish to be identified within the research. All interviews will be semi-structured to enable an informal and non-coercive conversation, which will develop in a nature that is appropriate for each participant. The consent form will clarify that they do not have to answer all questions if they feel uncomfortable in doing so. They will also be made aware that they can withdraw from the interview at any time without any disadvantage to themselves or the research. As the interviews will be semi-structured, the broad topics have been identified for questions, rather than including more specific and detailed questions (see Appendix).

Focus group:
The purpose of the focus group is for the researcher to gain in-depth understanding of local food waste-related barriers and norms that may not be captured in the survey.

Focus group participants will be recruited through the online survey questionnaire. The last question in the questionnaire will ask survey participants to indicate whether they would be willing to participate in a focus group that will take up to 90 minutes. Participants who answer ‘yes’ to that question will be asked to provide their name and email address so that they can be contacted directly. A maximum of six participants will be recruited.

If all focus group volunteers are willing, the meeting will be held in person, at a physical location on university grounds (permission pending). If focus group volunteers prefer to attend from a remote location, the meeting will be held via Zoom, arranged at a time that is convenient for all.

Written, informed consent will be acquired before the start of the focus group. Participants will be provided with an Information Sheet (see appendix), and they will be allowed enough time to read it and discuss aspects of the information sheet with the researcher. This will be sent out via email at least 24 hours before the scheduled meeting. The information sheet will include the aim and focus of the research; the nature of inputs being sought from participants; and the protocols of collection, storage, and the future use of the data.

At the beginning of the focus group, participants will be asked to sign a consent form to confirm they have understood the information provided and what they are being asked to do. Participants will be informed that every attempt will be made to protect their anonymity unless they explicitly state they wish to be identified within the research. The consent form will clarify that they do not have to answer all questions if they feel uncomfortable in doing so. They will also be made aware that they can withdraw from the interview at any time without any disadvantage to themselves or the research. During the focus group meeting the researcher will ask participants to provide their personal experiences of local food waste challenges, and they will also be welcome to discuss views and experiences among themselves. The style of the meeting will be informal, non-coercive and conversational; broad topics will be explored rather than following a list of specific questions (see appendix).

Survey:

The purpose of the online survey will be to collect data on local residents' experiences in terms of hindrances related to food waste minimisation and food waste management. Participants will be able to self-select to take part in the survey. The survey will be conducted entirely online using Qualtrics. A link to the survey will be advertised on social media and on University of Otago sustainability-related websites. It is anticipated that most participants will be tertiary students. Participants will be asked questions about their food waste habits and whether they experience ways in which their intentions to minimise food waste or divert food from the waste stream are being hindered. These questions will be in a range of styles including scales, rankings and open-ended written answers. The results will be analysed through descriptive analysis. A draft list of questions (not yet formatted for Qualtrics) is attached (see Appendix D)

Demographic information will be sought at the beginning of the survey in order to gain an understanding of the representativeness of the respondents, and thereby identify limitations in the sample. An introductory page in the survey platform will state the purpose of the research and contain the information sheet (see appendix C). The first page of the survey will state that by clicking the 'Submit' button, participants are providing their consent. The only personal details that will be collected are from those who volunteer for the focus group and provide their name and email address.

9. Disclose and discuss any potential problems and how they will be managed:

The research is not expected to involve any medical and legal issues. It is highly unlikely that any harm or discomfort will be encountered during the project. However, every attempt will be made to minimise potential harm by being fully aware of the context of the research. It will be made clear to the participants that their participation is entirely voluntary, and that they can decline to answer any question that they are not comfortable answering, and their choice will have no consequence.

The researcher is aware that due to the recent lockdown events associated with Covid-19, shifting to online methods such as Zoom is a strategy which could be used in lieu of face-to-face interviews. Due to added stress during this time, the interviewing techniques and survey questions will hopefully not place any added pressure on the participants, and it will be made clear that they can withdraw at any time. Audio recording of the interview will be undertaken, with the consent of the interviewees.

The survey is targeted towards residents of the tertiary precinct, and as a result, it is anticipated that the primary respondents will be students. The projected sample size for the survey is 100 respondents, who will have to deliberately decide to complete the online survey. Out of those respondents, it is hoped that a maximum of six respondents will agree to participate in the focus group.

Participants may have conflicting views on the issues discussed, but every effort will be made to ensure the anonymity of all participants, unless they prefer otherwise. Original interview transcripts will be anonymised to protect identities and any potential opinions expressed during interviews unless informants prefer otherwise.

The data collected will comprise of survey data, interview notes and transcriptions from interviews that have been digitally recorded. This data will only be accessible to the researcher and the supervisor. Electronic data will be stored on password protected computers, in line with the University of Otago requirements, and kept for up to five years, after which time it will be destroyed. After the completion of this research, all identifying personal information will be destroyed. All participants, if desired, will receive a copy of the thesis once it is complete.

If the participants are hesitant or uncomfortable about answering any questions, they have the right to decline to answer. If at any time they feel uncomfortable with the interview, they are free to ask for the interview to be discontinued without any disadvantage to themselves. They may withdraw the information provided at any stage up to 1st of October 2020.

This research may involve site visits to locations of food waste disposal or food purchase. Site visits will only be undertaken if permitted under current Covid-19 government protocol. The researcher will at all times comply with the health and safety procedures of the site which they are visiting. These visits will only occur with the prior consent of the land or business owner and in the company of authorised personnel. The researcher will avoid working with any vulnerable groups within this research.

***Applicant's Signature:**

Name (please print):

Date:

**The signatory should be the staff member detailed at Question 1.*

ACTION TAKEN

☐ Approved by HOD ☐ Approved by Departmental Ethics Committee

☐ Referred to UO Human Ethics Committee

Signature of **Head of Department*:* .....

Name of HOD (please print): …….

**Where the Head of Department is also the Applicant, then an appropriate senior staff member must sign on behalf of the Department or School.

Departmental approval: *I have read this application and believe it to be valid research and ethically sound. I approve the research design. The research proposed in this application is compatible with the University of Otago policies and I give my approval and consent for the application to be forwarded to the University of Otago Human Ethics Committee (to be reported to the next meeting).*

Exploring barriers to food waste minimisation and management practices among households in Dunedin's tertiary precinct

INFORMATION SHEET FOR INTERVIEW PARTICIPANTS

Thank you for showing an interest in this project. Please read this Information Sheet carefully before deciding whether or not to participate. If you decide to participate, we thank you. If you decide not to take part, there will be no disadvantage to yourself and we thank you for considering our request.

What is the aim of the project?
This research will seek to examine whether existing barriers to sustainable household food waste behaviours in Dunedin's tertiary precinct can be addressed through city planning. The study will incorporate considerations of the role of the built environment in this context.
A review of Dunedin planning documents will be carried out, and the views of local government staff, tertiary institution staff, student representatives, residents of the tertiary precinct, and representatives from local food networks will be explored. This will help the researcher understand whether barriers to sustainable household food waste behaviours in the tertiary precinct can be addressed from a planning perspective.

What types of participants are being sought?
The researcher would like to speak to key stakeholders in Dunedin who have an insight into and involvement in food waste issues and policies. This could include Council officials, tertiary institution staff, waste management institutions or companies, landscape architects, urban designers, residents, business owners, and community group members.

You are being requested to participate, and we also ask whether you can recommend other potential participants who would provide further insights into the research. Through this research, it is intended to document recommendations for strategies that might be implemented to better enable residents in the tertiary precinct to both minimise their food waste and also divert their domestic food waste from the municipal waste stream.

What will participants be asked to do?
Should you agree to take part in this project, you will be asked to undertake a semi-structured interview. No reward or compensation will be offered for your participation; it is purely voluntary. Should you agree to take part in this project, you will be asked to provide your views in an interview at a location and at a time that is convenient to you either in person or via zoom, of up to an hour in duration. Since this interview is semi-structured in nature, it will be based on a discussion of relevant themes. You will be asked to reflect on several broad topics related to food waste and food waste policy options. Although the School of Geography is aware of the general areas to be explored in the interview, the Committee has not been able to review the precise questions to be used.

If at any stage you feel uncomfortable, you may decline to answer any question, or request that the interview be terminated. The information gathered from the research will be made available to participants on request. Please be aware that you may decide (at any time) not to take part in the project without any disadvantage to yourself.

What data or information will be collected and what use will be made of it?
Interviews will be audio recorded, and subsequently transcribed for use in our research. Only the supervisor and the individual undertaking the research will have access to the identifiable data. Once the interview data are transcribed, the audio files will be deleted. Aliases and pseudonyms will be used to protect your identity unless you prefer otherwise. On the Consent Form you will be given options regarding your anonymity. Please be aware that, should you wish, we will make every attempt to preserve your anonymity. However, with your consent, there are some cases where it would be

preferable to attribute contributions made to individual participants. It is entirely up to you which of these options you prefer.

The final research report will be made available to the School of Geography. Direct quotations may be used to provide evidence supporting key points made in the report. Every effort will be made to ensure that individual identities are not revealed through these quotations unless you have chosen not to remain anonymous. Data obtained as a result of the research and personal information held on the participant will be retained for 5 years in secure storage, and then destroyed. You have the right to withdraw either part or all the provided information before 1st October 2020.

If you are hesitant or uncomfortable about answering any question, you are reminded of your right to decline to answer, and also that you may withdraw from the project at any stage without any disadvantage to yourself of any kind.

This project involves an open-questioning technique. The general line of questioning includes topics such as, community involvement in food waste-related behaviour change, the potential of the built environment to produce barriers or opportunities for sustainable food waste practices, and current waste-related policies. The precise nature of the questions that will be asked have not been determined in advance, but will depend on the way in which the interview develops. In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable, you are reminded of your right to decline to answer any particular question(s).

Can participants change their mind and withdraw from the project?

If you are hesitant or uncomfortable about answering any questions, you have the right to decline to answer. If at any time you feel uncomfortable with the interview, you are free to ask for the interview to discontinue without any disadvantage to yourself. You may withdraw the information provided at any stage up to the 1st of October 2020.

What if participants have any questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:

Elisabeth Boyle
School of Geography
Email: bisli150@student.otago.ac.nz

and

Dr Sean Connelly
School of Geography
Email: sean.connelly@otago.ac.nz

This study has been approved by the School of Geography. However, if you have any concerns about the ethical conduct of the research, you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (Ph +643 479 8256 or email gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

Exploring barriers to food waste minimisation and management practices among households in Dunedin's tertiary precinct

CONSENT FORM FOR

INTERVIEW PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:

1. My participation in the project is entirely voluntary.

2. I am free to withdraw from the project before its completion.

3. Personal identifying information will be destroyed at the conclusion of the project, but any raw data on which the results of the project depend will be retained in secure storage for at least five years.

4. This project involves an open-questioning technique. The general line of questioning focuses on barriers to sustainable food waste practices in relation to city planning. The precise nature of the questions which will be asked has not been determined in advance but will depend on the way in which the interview develops. In the event that the line of questioning develops in such a way that I feel hesitant or uncomfortable, I may decline to answer any particular question(s), and/or may withdraw from the project without any disadvantage of any kind.

5. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand), but every attempt will be made to preserve my anonymity.

I agree to take part in this project.

....
(Signature of participant) (Date)

.....
(Printed Name)

8. I, as the participant: a) agree to being named in the research ☐

b) would rather remain anonymous. ☐

Exploring barriers to food waste minimisation and management practices among households in Dunedin's tertiary precinct

INFORMATION SHEET FOR FOCUS GROUP PARTICIPANTS

Thank you for showing an interest in this project. Please read this Information Sheet carefully before deciding whether or not to participate. If you decide to participate, we thank you. If you decide not to take part, there will be no disadvantage to yourself and we thank you for considering our request.

What is the aim of the project?
This research will seek to examine whether existing barriers to sustainable household food waste behaviours in Dunedin's tertiary precinct can be addressed through city planning. The study will incorporate considerations of the role of the built environment in this context.
A review of Dunedin planning documents will be carried out, and the views of local government staff, tertiary institution staff, student representatives, residents of the tertiary precinct, and representatives from local food networks will be explored. This will help the researcher understand in which ways domestic households of the tertiary precinct are hindered in minimising their food waste or in diverting their food waste from the city's waste stream.

What types of participants are being sought?
The researcher would like to speak to residents of Dunedin's tertiary precinct who live in a private, domestic setting. Students who live in residential colleges do not fall into this category.

Through this research, it is intended to document recommendations for city planning strategies that might be implemented to better enable residents in the tertiary precinct to both minimise their food waste and also divert their domestic food waste from the municipal waste stream.

What will participants be asked to do?
Should you agree to take part in this project, you will be asked to take part in a focus group. A focus group is a term used for a group of people who are assembled to discuss a topic of interest and to give feed-back. No reward or compensation will be offered for your participation; it is purely voluntary. Should you agree to take part in this project, you will be asked to provide your views in an interview at a location and at a time that is convenient to you either in person or via zoom, of up to sixty in duration. You will be asked to reflect on several broad topics related to food waste and food waste policy options. You will also be able to discuss your experiences with the other focus group participants. Although the School of Geography is aware of the general areas to be explored in the interview, the Committee has not been able to review the precise questions to be used for discussion. There will be a maximum of six participants attending.

If at any stage you feel uncomfortable, you may decline to answer any question, or leave the focus group. The information gathered from the research will be made available to participants on request. Please be aware that you may decide (at any time) not to take part in the project without any disadvantage to yourself.

What data or information will be collected and what use will be made of it?
The focus group will be audio recorded, and subsequently transcribed for use in our research. Only the supervisor and the individual undertaking the research will have access to the identifiable data. Once the interview data are transcribed, the audio files will be deleted. Aliases and pseudonyms will be used to protect your identity unless you prefer otherwise. On the Consent Form you will be given options regarding your anonymity. Please be aware that, should you wish, we will make every attempt to preserve your anonymity.

The final research report will be made available to the School of Geography. Direct quotations may be used to provide evidence supporting key points made in the report. Every effort will be made to ensure that individual identities are not revealed through these quotations unless you have chosen not

to remain anonymous. Data obtained as a result of the research and personal information held on the participant will be retained for at least 5 years in secure storage, and then destroyed. You have the right to withdraw either part or all the provided information before 1st October 2020.

If you are hesitant or uncomfortable about answering any question, you are reminded of your right to decline to answer, and also that you may withdraw from the project at any stage without any disadvantage to yourself of any kind.

The format of the focus group will be informal and relaxed. The general line of questioning includes topics such as, what are currently the most common ways that households in the tertiary precinct deal with or minimise domestic food waste, common barriers experienced by local households in relation to sustainable food waste habits and behaviours, the role of the local built environment in relation to food waste habits and behaviours, and suggestions on how food waste in the tertiary precinct could be better addressed. The precise nature of the questions that will be asked has not been determined in advance, but will depend on the way in which the interview develops. In the event that the line of questioning does develop in such a way that you feel hesitant or uncomfortable, you are reminded of your right to decline to answer any particular question(s).

Can participants change their mind and withdraw from the project?

If you are hesitant or uncomfortable about answering any questions, you have the right to decline to answer. If at any time you feel uncomfortable with the interview, you are free to ask for the interview to discontinue without any disadvantage to yourself. You may withdraw the information provided at any stage up to the 1st of October 2020.

What if participants have any questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:

Elisabeth Boyle
School of Geography
Email: bisli150@student.otago.ac.nz

and

Dr Sean Connelly
School of Geography
Email: sean.connelly@otago.ac.nz

This study has been approved by the School of Geography. However, if you have any concerns about the ethical conduct of the research, you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (Ph +643 479 8256 or email gary.witte@otago.ac.nz). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

Exploring barriers to food waste minimisation and management practices among households in Dunedin's tertiary precinct

CONSENT FORM FOR

FOCUS GROUP PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:

1. My participation in the project is entirely voluntary.

2. I am free to withdraw from the project before its completion.

3. Personal identifying information will be destroyed at the conclusion of the project, but any raw data on which the results of the project depend will be retained in secure storage for at least five years.

4. This project involves an open-questioning technique and a discussion of opinions and experiences may ensue among participants during the focus group. The general line of questioning focuses on barriers to sustainable food waste practices in relation to city planning. The precise nature of the questions which will be asked has not been determined in advance but will depend on the way in which the focus group develops. In the event that the line of questioning or discussion develops in such a way that I feel hesitant or uncomfortable, I may decline to answer any particular question(s), and/or may withdraw from the project without any disadvantage of any kind.

5. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand), but every attempt will be made to preserve my anonymity.

I agree to take part in this project.

....
(Signature of participant) (Date)

.....
(Printed Name)

8. I, as the participant: a) agree to being named in the research ☐

b) would rather remain anonymous.

Appendix A

Semi-structured interview questions: themes that will be covered in interviews with stakeholders

- Local Authorities and tertiary institution staff:
    - Existing issues related to food waste issues in the tertiary precinct
        - Challenges presented by the built environment
        - Opportunities presented by the built environment
    - Policies and planning documents
        - Is the scope for food waste wide enough?
        - Do they incorporate the built environment sufficiently?
        - Do they allow for decentralised composting?
    - Local community public consultation
        - Results received from previous public consultation on food waste, if any
    - Future direction
        - What the local government officials would like to see for the future direction of food waste policy making in Dunedin

- Waste management staff and local food networks:
    - Existing issues related to food waste issues in the tertiary precinct
    - Existing barriers to food waste minimisation in the tertiary precinct
    - Existing barriers to sustainable food waste management in the tertiary precinct
    - Challenges presented by the built environment in terms of diverting food waste from the municipal waste stream
    - Viability of community gardens in the tertiary precinct
    - Viability of decentralised composting hubs in the tertiary precinct

Appendix B

Focus group themes that will be offered for discussion and feedback

- Existing issues related to food waste issues in the tertiary precinct
- Existing barriers to food waste minimisation in the tertiary precinct
- Existing barriers to sustainable food waste management in the tertiary precinct
- Challenges presented by the built environment in terms of diverting food waste from the municipal waste stream
- Viability of community gardens in the tertiary precinct
- Viability of decentralised composting hubs in the tertiary precinct

Appendix C

Exploring barriers to food waste minimisation and management practices among households in Dunedin's tertiary precinct

INFORMATION SHEET FOR SURVEY PARTICIPANTS

Thank you for showing an interest in this project. Please read this information carefully before deciding whether or not to participate. If you decide not to take part, there will be no disadvantage to you, and we thank you for considering our request. You may withdraw from the project at any time before its completion without any disadvantage to yourself.

This project is being undertaken as part of the requirements for a Master of Planning degree at the University of Otago.

Project aim
The research will examine whether existing barriers to sustainable household food waste behaviours in Dunedin's tertiary precinct can be addressed through city planning. We are interested in:

- What hinders households from separating their food waste from the weekly rubbish bin/bag, and
- What hinders households from preventing the waste of food in the first place.

Survey details
The research participants sought for this survey are private residents of Dunedin's tertiary precinct who are 18 years of age or older and who live in flats or houses (not residential colleges).

The survey is expected to take no more than 10 minutes.

The raw data and information collected from the surveys will be stored safely in a password protected folder only accessible by the student researcher and her supervisor (both of which are named below). Raw data will be kept for at least five years before being destroyed. The data will be analysed and used in a final research report written by the student researcher. Results of this research may be published.

The only identifying information that will be collected will be the names and email addresses of survey participants who volunteer to attend a group discussion (also called a focus group) about food waste. Signing up for the focus group is entirely voluntary and is done at the last question of the survey. These names and email addresses will only be collected for the purpose of arranging the focus group and will be destroyed as soon as the research project has been completed. All efforts will be made to protect the identity of focus group participants. No identifying information will be collected from any survey participants who do NOT sign up to attend the focus group.

While direct quotes from statements made in the survey may be used in these researcher's final report, no personal details, names, or identifying features will be revealed.

By clicking the 'Submit' button at the end of this survey, you give your consent to participate, and for the data provided to be used as part of the research project mentioned above.

If you agree to take part in this survey, please click the 'Yes' button below to indicate that you have read and understood this information.

If you have any questions about this project, please feel free to contact:

Dr Sean Connelly
School of Geography, University of Otago
Dunedin, 9016
Email: sean.connelly@otago.ac.nz

OR

Elisabeth Boyle
School of Geography, University of Otago
Dunedin, 9016
Email: bisli150@student.otago.ac.nz

This study has been approved by the Department stated above. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

Consent to participate

I have read and understood the subject information provided above. I understand that my participation is entirely voluntary and that I may decline to participate in the survey or that I may withdraw from it at any time. I understand that there is no guarantee that this survey will provide any benefits to me. I have had sufficient time to consider the information provided. I understand that all the information collected will be kept private and that the results will be used to study existing barriers to food waste minimisation and management practices among private households in Dunedin's tertiary precinct.

1) Yes
2) No

Appendix D

Online survey questionnaire

20) Are you a resident of Dunedin's tertiary precinct?

a) Yes
b) No

21) Which option best matches your occupancy status?

a) Student
b) Professional
c) Other

22) How many people live in your household?
Free text _____

23) Does the house of flat you live in contain some outdoor, ground-level recreational space, such as a back yard?
(Please circle one of the options below)

a) Yes
b) No

24) To what degree do you agree with the statements below?

Statement	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Food waste represents a waste of the world's resources such as land, water and nutrients					
Food waste is unethical					
Emissions from food waste contribute to climate change					

Food waste is a waste of my money					
Placing food waste in the recycling bin causes contamination and wastes the council's resources					

25) How satisfied are you about your household's ability to minimise food waste? *(Please circle one of the options below)*

Very satisfied satisfied neutral unsatisfied very unsatisfied

26) What kind of methods does household use to minimise food waste, if any (e.g., making shopping lists, eating leftovers, etc)?

Free text

_____

27) What prevents your household from minimising your domestic food waste?

Free text

_____

28) What kind of methods does your household use to prevent throwing food waste in the weekly rubbish collection bin/bag?

Free text

_____

29) What prevents your household from keeping food waste out of the weekly rubbish bin/bag?

Free text

_____

30) Does the built environment (e.g., physical infrastructure, roads, open spaces, buildings, paving, etc.) in your neighbourhood prevent you or your household from minimising food waste?

a) Yes
b) No

If you indicated 'yes' to the previous question, please explain further in your own words:

Free text

_____

31) Please indicate which of the two below options for diverting food waste from the rubbish tip you would prefer if they were offered in your neighbourhood:

a) The use of bins specifically issued for food waste, collected once per week by the city council.
b) The use of bins specifically issued for food waste, emptied by each household at community composting hub in their neighbourhood, at times that suit each individual household.

32) If a community garden and composting hub complex were available in your neighbourhood, would you take part in it?
(Please circle one of the options below)

a) Yes
b) No

33) What do you think is the most challenging thing about food waste?

Free text

_____

34) Do you have any suggestions to how food waste issues could be addressed by the council in the tertiary precinct?

Free text

_____

35) Would you be interested in attending a focus group to allow for a more in-depth discussion on food waste-related issues in your neighbourhood?
(Please circle one of the options below)

a) Yes
b) No

If you indicated ‘yes’ to the previous question, please provide your name and email address below:

Free text

_____

Appendix I: Map of selected streets for the Tertiary Precinct upgrade

Appendix J: Meaning of themes for households' ability to minimise food waste

Method themes	Meaning
Eating leftovers	Meal leftovers are eaten rather than thrown out
Sharing food	Individuals within households share food with others when they have more food than they can eat
Bring lunch from home	Individuals either make lunch at home or bring ingredients with them from home to their place of study
Buy/Cook/portion appropriate quantities	Households consciously either cook or portion out smaller quantities to avoid food being left over
Shopping strategies	Households or individuals shop strategically according to a shopping list to avoid purchasing food that may not get eaten
Meal planning	Households or individuals plan ahead for meals to incorporate shopping strategies, leftovers or existing food stock
Food stock management	Households or individuals manage and monitor existing food stocks in order to use up or preserve before it is spoiled/expires. Includes freezing.
Smaller bin size	Household has consciously reduced the size of their bin to remind them to reduce their waste
Nothing	Individuals or households make no effort to avoid wasting food
Composting	Household composts their own food scraps
Use personal judgement re edibility	Individuals or households do not slavishly stick to Best Before dates on packaging, but also choose to be guided by their own judgement